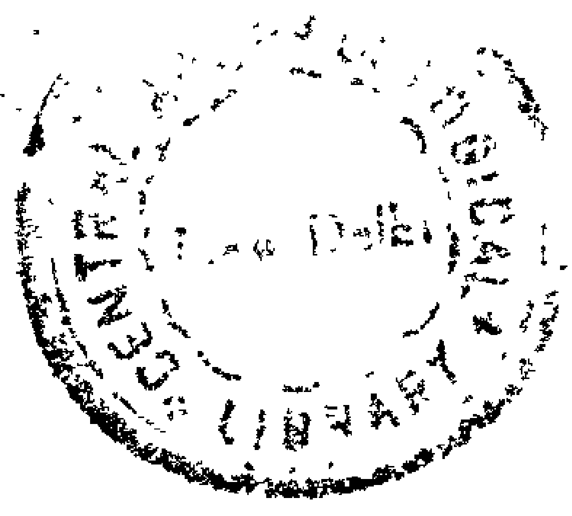

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ANCIENT INDIA

Bulletin of the Archaeological Survey of India

NUMBER 14
1958



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NOTES

THIS year, Parliament of India passed the Ancient Monuments and Archaeological Sites and Remains Act, 'to provide for the preservation of ancient and historical monuments and archaeological sites and remains of national importance, for the regulation of archaeological excavations and for the protection of sculptures, carvings and other like objects'. As the archaeological pursuits in any country are vitally linked up with, and sometimes dependent on, its laws relating to antiquities, the new Act may provide an occasion for a brief review of the relevant laws in India.

* * * * * *

In the second half of the last century, the Government of India first seriously realized its responsibilities towards the ancient heritage of the land. The policy was no doubt vacillating and lacking in firmness, for the nature and extent of the responsibilities of the State in this direction were debated again and again, and retrograde views often had the upper hand. Yet, it is remarkable that it was in one of the gloomy intervals, in 1878, that the Treasure-trove Act came into being, which, judged even by the present-day standards, is striking for its provisions, for they include the compulsory declaration of archaeological discoveries by the finder and the acquisition by the State of important objects on payment of compensation.

Valuable antiquities have come into national possession through the application of this Act and now enrich the museums all over the country. But, to say this is not to admit that its provisions have always been rigorously enforced or that all antiquities that could have been acquired through it have been acquired: for, it is common knowledge that, in spite of the Act, metallic objects have been frequently melted down for the value of the metal; varied art-objects lie scattered all over the country and have not been seized. Further, as the administration of the Act is decentralized, its application has not been uniform. However, the Government of India has of late taken renewed interest in the matter and has framed a set of model rules for all State Governments to adopt.

* * * * * *

Twenty years later, in 1898, during another dismal period in the history of Indian archaeology, the Government became alive to the necessity of preventing the spoliation of the antiquarian wealth of the country, whether in the name of scientific research or for

franker and more utilitarian purposes. During the next six years, information about the laws of different countries was collected and a draft bill was prepared and widely circulated. The actual enactment took place in 1904 in the form of the Ancient Monuments Preservation Act, 'to provide for the preservation of ancient monuments, for the exercise of control over traffic in antiquities and over excavation in certain places, and for the protection and acquisition in certain cases of ancient monuments and of objects of archaeological, historical or artistic interest'.

In substance, the Act provided for (i) the preservation of protected monuments by agreement with the owner, if any, though his proprietary rights were not to be infringed in any way, (ii) the ensurance of the observance of religious rites in monuments, (iii) the compulsory purchase, if need be, of monuments and antiquities not in religious use, (iv) the control over traffic in antiquities and over the moving of antiquities from the place of their origin, (v) the regulation of excavations in protected areas and (vi) the punishment for destroying, removing, injuring, altering, defacing or imperilling a protected monument and for other miscellaneous offences under the Act.

The successive constitutional changes in the country necessitated amendments of an administrative nature in the Act. For example, whereas the original Act entrusted the function of protection of monuments, etc., to the Provincial Governments, after the Government of India Act of 1935, which made archaeology a 'Federal' subject, the Act had to be amended so as to transfer these functions to the Central Government. In 1932, however, had taken place a major amendment, which allowed the issue of licences to outside agencies for the excavation of protected areas and to control the mining, quarrying, excavating, blasting, etc., at or near protected monuments.

Caution in all directions—protection of owners' rights, non-interference with religious usages, compensation for anything acquired or any right infringed—pervaded the whole of the Act, for such caution was necessary at that time, as it is equally necessary even now. Even though, therefore, the Act might have fallen short, in certain directions, of the expectations of archaeological administrators and lovers of antiquities, it has nevertheless stood the test of time: the very fact that its main framework remained unaltered for more than fifty years is a sufficient testimony to its workability and practical approach to the administrative problems of monuments and sites.

With the passage of time, however, it was becoming increasingly clear that certain changes were needed in the Act. For example, the vesting of most of the functions under the Act in the administrative district officers, to the exclusion of the officers responsible for the preservation of monuments and excavation of sites, was fast becoming an anachronism. Further, the Act did not provide against the recalcitrant owner of a monument who refused to enter into agreement with the Government and could thus make many provisions of the Act infructuous. Again, with the evergrowing building activities all over the country and the consequent pressure on land, modern constructions were cropping up in very close proximity to important monuments, thus seriously affecting their aesthetic value and the landscape. Finally, the Act had to be brought into line with the provisions of the Constitution, which makes the Central Government responsible only for 'ancient and historical monuments...... and archaeological sites and remains declared by or under law made by Parliament to be of national importance' and further makes 'archaeological sites and remains other than those declared by or under law made by Parliament to be of national importance' a concurrent subject, the residue going to the States. The new Act, referred to above, is the response to these needs.

This Act is broadly based on the 1904-Act, for there was no necessity for any radical departure therefrom. In addition to comprehending within its scope all the

monuments and sites which have already been declared to be of national importance (or, in other words, which are Centrally protected), it provides for the inclusion of additional monuments and sites by notification and also for the withdrawal of protection if necessity arises. Further, the shortcomings of the old Act mentioned above have been removed by (i) devolving many of the functions of the district officers upon the officers of the Department of Archaeology, (ii) empowering the Government to assume some powers in regard to the monuments the owners of which refuse or fail to enter into agreement with the Government, and (iii) prohibiting the construction of buildings within protected areas and enabling the Department to prohibit the construction of buildings on or near the sites of protected monuments. The Act also authorizes the Department to undertake excavations in unprotected areas (a point on which the old Act was silent) and forbids the State Governments to undertake or authorize any person to undertake excavation without the approval of the Central Government (an obvious corollary of archaeological sites and remains not of national importance forming a concurrent subject). To safeguard the interest of the owner of an excavated land, the Act provides for the payment of compensation not only for the damage done to the land but also for the antiquities that may be removed by the excavator, but, in national interest, simultaneously lays down that in assessing the amount of the compensation for the antiquities, any increase in their value by reason of their being of historical or archaeological importance will not be taken into consideration.

The Act will not apply to monuments which have not been declared to be of national importance, i.e., which are to be maintained by the States. Such State Governments as have no law at present for the preservation of their monuments are being encouraged to promote legislation.

* * * * * *

Of particular interest to the foreign readers of this Journal would be the legal provisions about the export of antiquities out of India. In this country there is no total ban on export, as exists in some countries of both Europe and Asia. However, under the Antiquities (Export Control) Act, 1947, no antiquity, which term has been given a comprehensive definition but does not include any object less than one hundred years old, can be taken out without a licence issued by the Central Government, applications for licences having to be made to the Director General of Archaeology in India, who is authorized to decide whether an object is or is not an antiquity for purposes of the Act.

The Act also applies to antiquities falling to the share of a person who excavates a site of national importance with a licence and who intends to take his share out of India. The principles for the disposal of excavated antiquities have still to be declared by the Government under the recent Act, but it is unlikely that they will widely differ from those already declared under the 1904-Act, namely that human relics of historical and religious importance and any antiquity which the Government regards as of national importance will be retained in India and that of the rest the excavator will be allowed to have such portion of the antiquities as is sufficient, in the opinion of the Government, to recompense him for the expenditure incurred by him on the excavation.

A. GHOSH

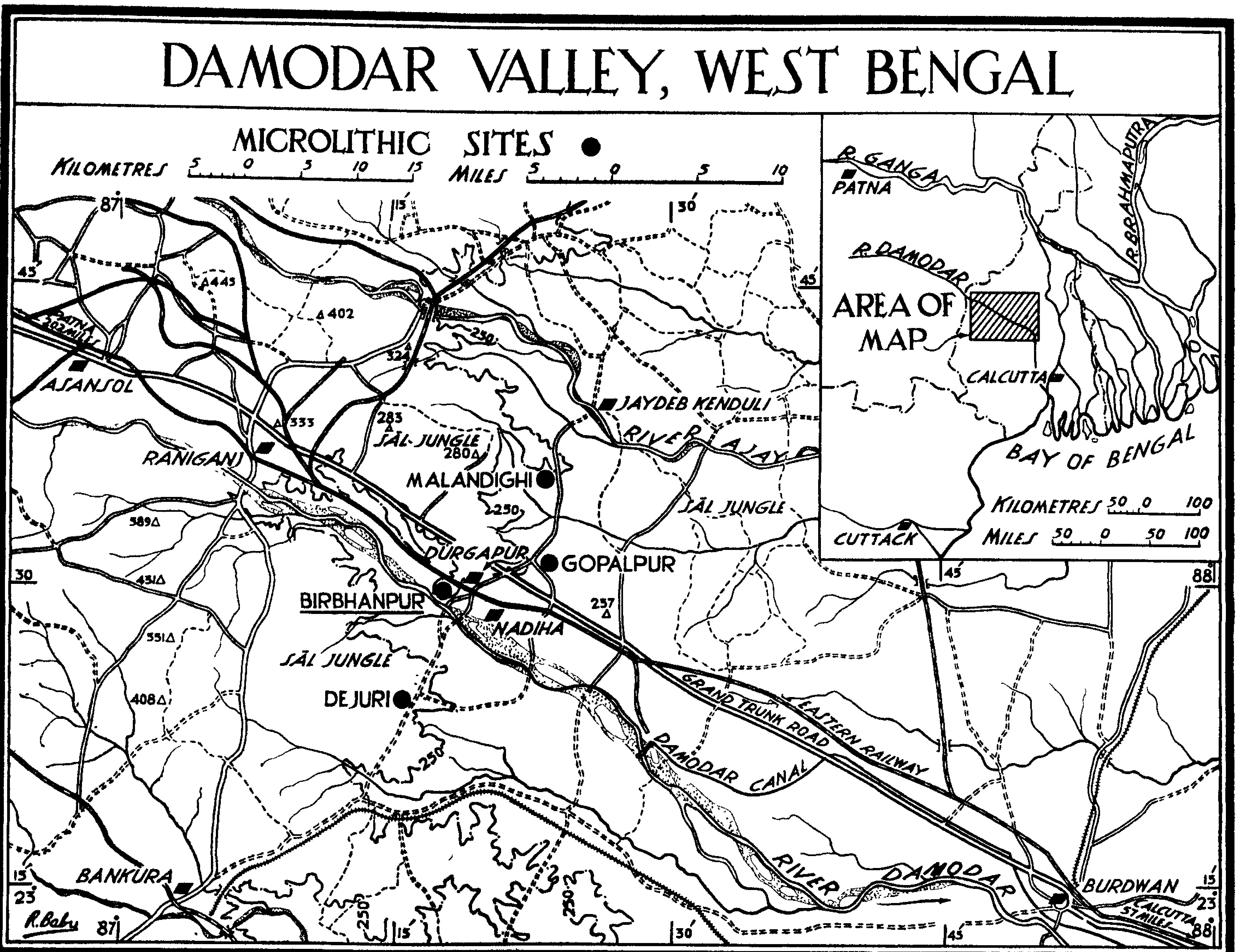

DAMODAR VALLEY, WEST BENGAL
MICROLITHIC SITES
KILOMETRES 5 0 5 10 15
MILES 5 0 5 10
R. GANGA
PATNA
R. DAMODAR
R. BRAHMAPUTRA
AREA OF MAP
CALCUTTA
BAY OF BENGAL
CUTTACK
KILOMETRES 50 0 100
MILES 50 0 50 100
ASANSOL
PATNA 302 MILES
RANIGANJ
JAYDEB KENDULI
RIVER AJAY
SĀL JUNGLE
MALANDIGHI
DURGAPUR
GOPALPUR
BIRBHANPUR
NADIHA
SĀL JUNGLE
DEJURI
GRAND TRUNK ROAD
EASTERN RAILWAY
DAMODAR CANAL
RIVER DAMODAR
BANKURA
BURDWAN
CALCUTTA 57 MILES
R. Babu

FIG. 1

BIRBHANPUR, A MICROLITHIC SITE IN THE DAMODAR VALLEY, WEST BENGAL

By B. B. LAL

CONTENTS

1. INTRODUCTORY

IN January 1954, when, as Superintendent of the Eastern Circle of the Department, the author was touring in Burdwan District, West Bengal, his attention was drawn to a microlithic site near Durgapur (23°29′ N. Lat. and 87°19′ E. Long.; fig. 1) by Shri Ajit Kumar Mukerji, a landlord of the locality. The site lies to the west of the road leading from the Durgapur railway-station to the village of Birbhanpur on the bank of

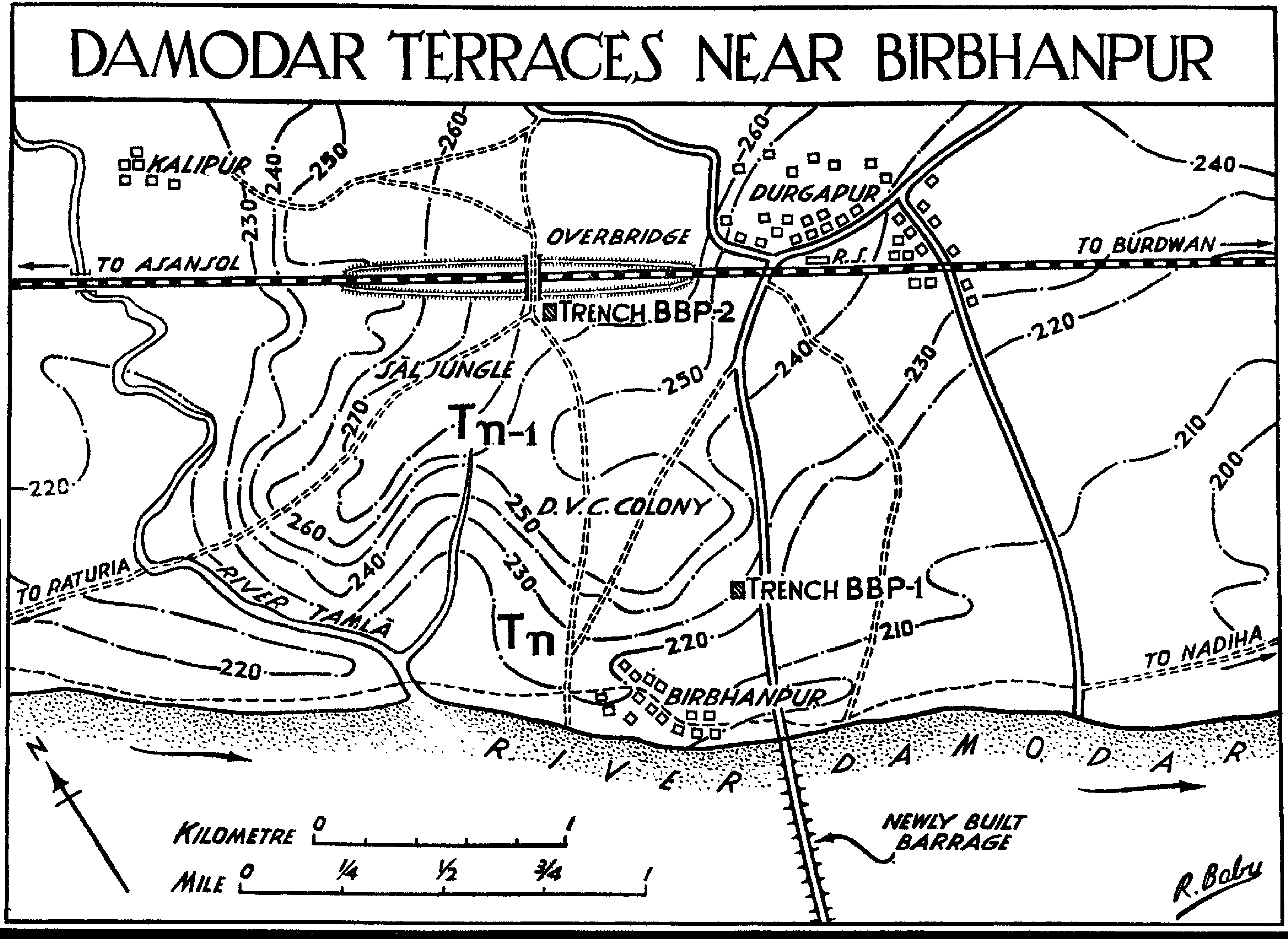

DAMODAR TERRACES NEAR BIRBHANPUR
KALIPUR
DURGAPUR
OVERBRIDGE
R.S.
TO ASANSOL
TO BURDWAN
TRENCH BBP-2
SAL JUNGLE
Tn-1
D.V.C. COLONY
TRENCH BBP-1
Tn
TO RATURIA
RIVER TAMLA
BIRBHANPUR
TO NADIHA
RIVER DAMODAR
NEWLY BUILT BARRAGE
KILOMETRE 0 1
MILE 0 ¼ ½ ¾ 1
N
R. Babu
200
210
220
230
240
250
260
270

Fig. 2

the Damodar river (fig. 2). Although neither the old town of Durgapur nor the village of Birbhanpur is located on the microlithic site, the site has been named after Birbhanpur as it falls within the revenue jurisdiction of that village. In recent years, however, the Damodar Valley Corporation has set up a colony (pl. I) in the area in connexion with the construction of a barrage on the Damodar (which has since been completed) and other industrial activities.

As during this visit the author was preoccupied with other duties, only about a week's work, which included both surface-exploration and the excavation of a small trench, named BBP-1,[1] was carried out at the site. The excavation revealed that the microliths lay in a geological context and were not associated with any pottery. As both these points were important, the author wanted to check them up fully by some further work in the area. This, however, could not be done soon, as he was transferred from the Eastern Circle in July 1954. It is only recently, between February 20 and March 5, 1957, that he was able to find time to do further field-work at the site. The present report embodies the results of the two seasons' work.

During the field-work of 1954, the author was assisted by Shri I. B. Saha, Shri S. K. Neogi and Shri K. C. Das, respectively Conservation Assistant, Draftsman and Photographer of the Eastern Circle, besides his wife, Sm. Kusum Lal. The 1957-team consisted of Shri H. Sarkar, Technical Assistant, Shri Amir Singh, Draftsman, Shri B. P. Asthana, Photographer, and Shri H. M. Ramsinghani, Steno-typist (who also assisted in the field-work)—all of the Director General's office. Shri H. Sarkar further helped the author in analysing the excavated material. The drawings have been prepared variously by Shri Amir Singh and Shri Ram Babu, the latter also of the Director General's office. The photographs of the microliths are by Shri Asthana. To all these persons the author's grateful thanks are due.

The author is particularly beholden to Dr. B. B. Lal, Archaeological Chemist in India, Dehra Dun, for analysing the soil-samples from the excavations and to Dr. K. A. Chowdhury, Professor of Botany, Muslim University, Aligarh, and Shri S. S. Ghosh, Wood Technologist, Forest Research Institute, Dehra Dun, for examining specimens of fossil-wood obtained at the site.

2. THE SITE AND ITS TOPOGRAPHY

As stated above the microlithic site has been named after the village of Birbhanpur, although the village itself is not situated on the microlithic area. The site is fairly extensive. Beginning from about a furlong north of Birbhanpur, it continues beyond the railway-line on the north. On the east it is roughly bounded by the road between Durgapur railway-station and Birbhanpur and it continues well into the jungle of *sāl*-tree (Shorea robusta) on the west (fig. 2; pl. I). Thus, it covers an area approximately a square mile.

In the locality two terraces of the Damodar can be seen: they are the youngest and youngest but one. As still older terraces are expected to exist further north and west where the land rises to a height of 589 ft. above the mean sea-level (fig. 1), these two terraces have been provisionally numbered T_n and T_{n-1} (figs. 2 and 3). Their actual number in the terrace-sequence from top downwards can be determined only when the upper terraces have been explored; hence this provisional numbering.

[1] BBP is an abbreviation of 'Birbhanpur'.

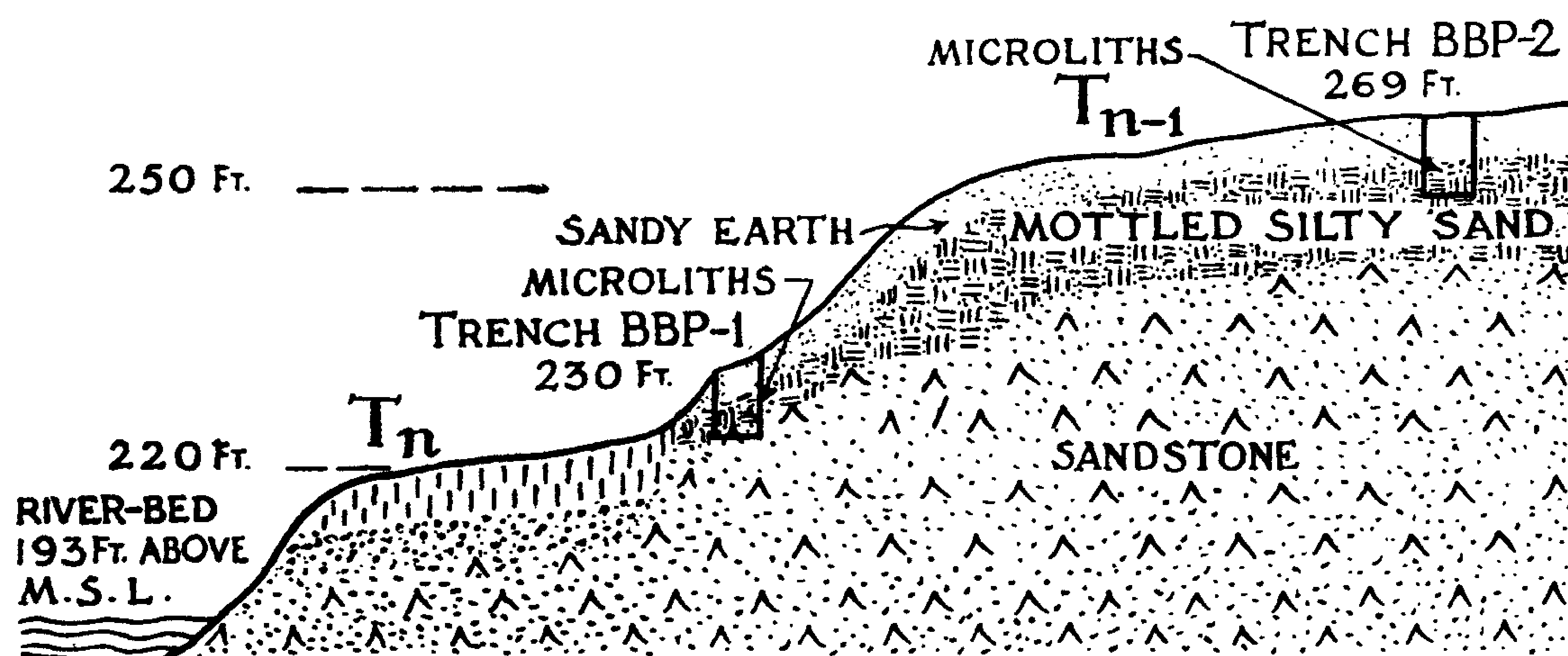


FIG. 3

The sandy bed of the river here is 193 ft. above the mean sea-level.[1] The low water-level is 196 ft. above that level, but during the floods, the river has been noted to rise to a maximum height of 210 ft. The youngest terrace (T_n), on which a part of Birbhanpur village is situated and which can be seen in the form of a flat plain to the west of that village, has a level between 220 and 226 ft. The Engineering Department of the Damodar Valley Corporation has made several borings in this terrace, all of which reveal more or less similar stratigraphy. Below is given the section of one such boring:

BORING NO. 23/2

(Surface-level 224·36 ft. above mean sea-level)

Depth below surface		*Material*
0– 2 ft.	...	Top earth, loam
2– 5 ft.	...	Clay, light yellowish
5–10 ft.	...	Hard clay mixed with sand
10–15 ft.	...	Hard clay with more sand
15–16 ft.	...	Coarse sand, medium
16–20 ft.	...	Sand and gravel
20–21 ft.	...	Sandstone (crust)
21–22 ft.	...	Sandstone, soft
22–24 ft.	...	Sandstone, soft, brownish
24–27 ft.	...	Sandstone, light red

The composition of the strata from the surface down to the depth 20 ft. clearly shows that they were laid down by the river.

[1]The author is thankful to the Executive Engineer, Damodar Valley Corporation, Durgapur, for his kind help in ascertaining the levels of various places in the locality and for supplying a contour map of the area on which fig. 2 is based.

It may be added that no microliths were obtained from this terrace.

The next higher terrace, viz. T_{n-1}, has a level of 269 ft. near Trench BBP-2 (figs. 2 and 3). Towards the north-west, in the *sāl*-jungle, it rises to a maximum of 278 ft., while eastwards it slopes down to even lower than 250 ft. On the north, across the railway-line, the level is somewhat higher than what it is near Trench BBP-2, but as one moves towards the river on the south, the level slowly but certainly goes down and, at a distance of about a hundred yards north of Birbhanpur, it suddenly falls from about 250 ft. to 230 ft., thus bringing the terrace to an end. The considerable difference between the maximum and minimum levels of the terrace may be due, amongst other factors, to the sloping nature of the bed-rock[1] and the erosional processes that have been going on ever since the formation of the terrace.

Observations made in the railway-cutting, in the sections of a nullah which drains off the water from this terrace (T_{n-1}), and in the two excavated trenches, viz. BBP-1 and BBP-2 (figs. 4 and 5; pls. II and III) combined to show that the top 2 to 2½ ft. of this terrace consisted of sandy earth, laid under semi-arid conditions. Underneath this deposit lay mottled silty sand with occasional lateritic pallets, sometimes over 10 ft. in thickness (Trench BBP-2), within the upper 1½ ft. of which was embedded the microlithic industry under consideration.[2] The mottled silty sand represents the weathering *in situ* of the underlying rock, viz. medium-grained, whitish sandstone.

3. THE TRENCHES

In January 1954, a small trench, named BBP-1, was laid out at the southern extremity of the microlith-bearing terrace, T_{n-1}, about 2 furlongs to the north-east of Birbhanpur village (fig. 2). During that season it was only partly excavated, although the microlithic levels were duly encountered. In February 1957, further work was carried out in this Trench, and a new Trench, BBP-2, was also laid out, in the northern part of the terrace (figs. 2 and 3; pls. I and III), in order to cross-check the evidence from the first Trench. The stratigraphy and other outstanding features met with in these trenches are described below.

A. Trench BBP-1

Measuring 24×8 ft. on the surface,[3] Trench BBP-1 was excavated, with a gentle slope of the sides, to an average depth of 7½ ft., whereafter a restricted area in the middle, 5×4 ft., was further carried down, reaching a total depth of 12 ft. below the surface. The excavation revealed five different deposits, which, from bottom upwards, were as follows (fig. 4; pl. II).

The lowest deposit, labelled as layer 5, was a highly decayed coarse-grained sandstone, generally whitish but sometimes having black streaks and somewhat pinkish granules. Layer 4, about 1½ to 2 ft. thick, consisted of mottled silty sand having white and red patches

[1] In the railway-cutting north of Trench BBP-2 the bed-rock (sandstone) was observed to slope both towards the east and south.

[2] This is a general description of the terrace (T_{n-1}) as a whole. In Trench BBP-1, which was at a lower level, the nature of deposits was, however, somewhat different, although the sequence in essence was the same.

[3] The level was about 230 ft. above mean sea-level.

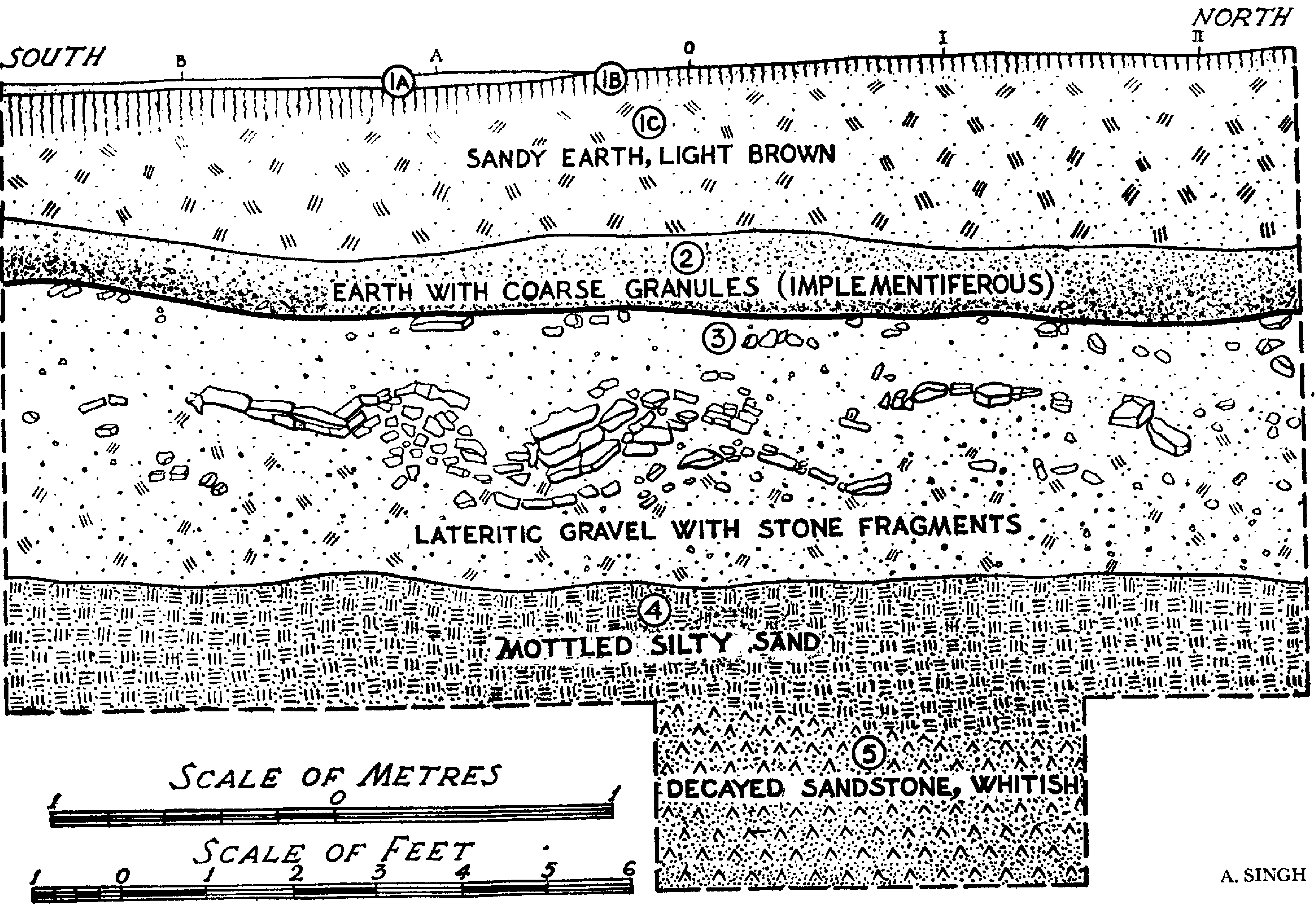

BIRBHANPUR 1957: TRENCH BBP-1, SECTION
SOUTH
NORTH
B
A
0
I
II
IA
IB
IC
SANDY EARTH, LIGHT BROWN
2
EARTH WITH COARSE GRANULES (IMPLEMENTIFEROUS)
3
LATERITIC GRAVEL WITH STONE FRAGMENTS
4
MOTTLED SILTY SAND
5
DECAYED SANDSTONE, WHITISH
SCALE OF METRES
1 0 1
SCALE OF FEET
1 0 1 2 3 4 5 6
A. SINGH

FIG. 4

and representing the weathering *in situ* of the underlying sandstone. The next higher deposit, represented by layer 3, comprised lateritic gravel and stone fragments in a silty matrix which had got consolidated. The stone fragments very likely represent an iron pan which was produced as a result of the deposition of hydrated iron oxide through the percolation of water (below, p. 47).

The top of layer 3, somewhat undulating, formed the land-surface over which the microlithic man lived. The layer yielding the microliths themselves, viz. no. 2, consisted of earth mixed with coarse granules mainly of quartz and haematite. The thickness of the deposit varied from 8 in. to 1 ft., wherein it was further observed that the lower portion was more compact and reddish than the upper. It was also noted that even out of this limited thickness of 1 ft. at the outside, it was the lower 6 to 8 in. that yielded the main bulk of microliths, there being only sporadic occurrence of the specimens in the upper portion.

Besides the microliths the only other object of interest discovered in the Trench was a fragmentary stone with a ridge, another specimen roughly similar to which was discovered in Trench BBP-2 also (p. 13; pl. IV B). The BBP-1 specimen was found in association with a core of quartzite pebble, about a score of waste flakes and a couple of retouched tools. A negative evidence must also be mentioned here, namely that no pottery was found in association with the microlithic industry.[1]

Of particular interest was the deposit that overlay the microlithic layer. It consisted of sandy earth having an average thickness of $2\frac{1}{4}$ ft. Of it, the upper 4 to 6 inches, marked 1B, were darker in appearance than the remaining lower portion, marked 1C, which was light-brown. An analysis of this deposit has revealed that it was laid down under semi-arid conditions and that it has undergone weathering since its deposition. The significance of these observations will be discussed later (pp. 38, 39, 47 and 48).

B. Trench BBP-2

As already stated above, Trench BBP-2 was laid out primarily to cross-check the evidence obtained from Trench BBP-1, and it must straight away be stated that it duly fulfilled the purpose. It confirmed that the microlithic industry was entirely unassociated with any kind of pottery and that the implementiferous layer was finally sealed by the same sandy earth as was encountered in Trench BBP-1. The details of Trench BBP-2 are as follows.

Located at a distance of about a mile to the north of Trench BBP-1 and about 100 yards to the south of the railway-overbridge (which itself is about 6 furlongs to the north-west of Durgapur railway-station), Trench BBP-2 was laid out on a fairly even ground, the local level being about 270 ft. above the mean sea-level. The land gently rises to the north and west, the maximum, however, never reaching 280 ft. These slightly higher regions are covered by a young *sāl*-jungle (fig. 2; pl. I).

The Trench measured $12 \times 7\frac{1}{2}$ ft. However, leaving a $2\frac{1}{2}$-ft. wide baulk in between, it was supplemented by a parallel trench on the eastern side, named BBP-2—Eastern Extension, which was finally enlarged to the same dimensions as the main Trench itself. Excavations were carried out in most of the area in these two Trenches to an average

[1] A few sherds of a reddish brown ware did occur in a shallow pit near the surface, but as they were later than even layer 1B, they could have hardly anything to do with the microlithic industry of layer 2.

BIRBHANPUR 1957: TRENCH BBP-2, SECTION

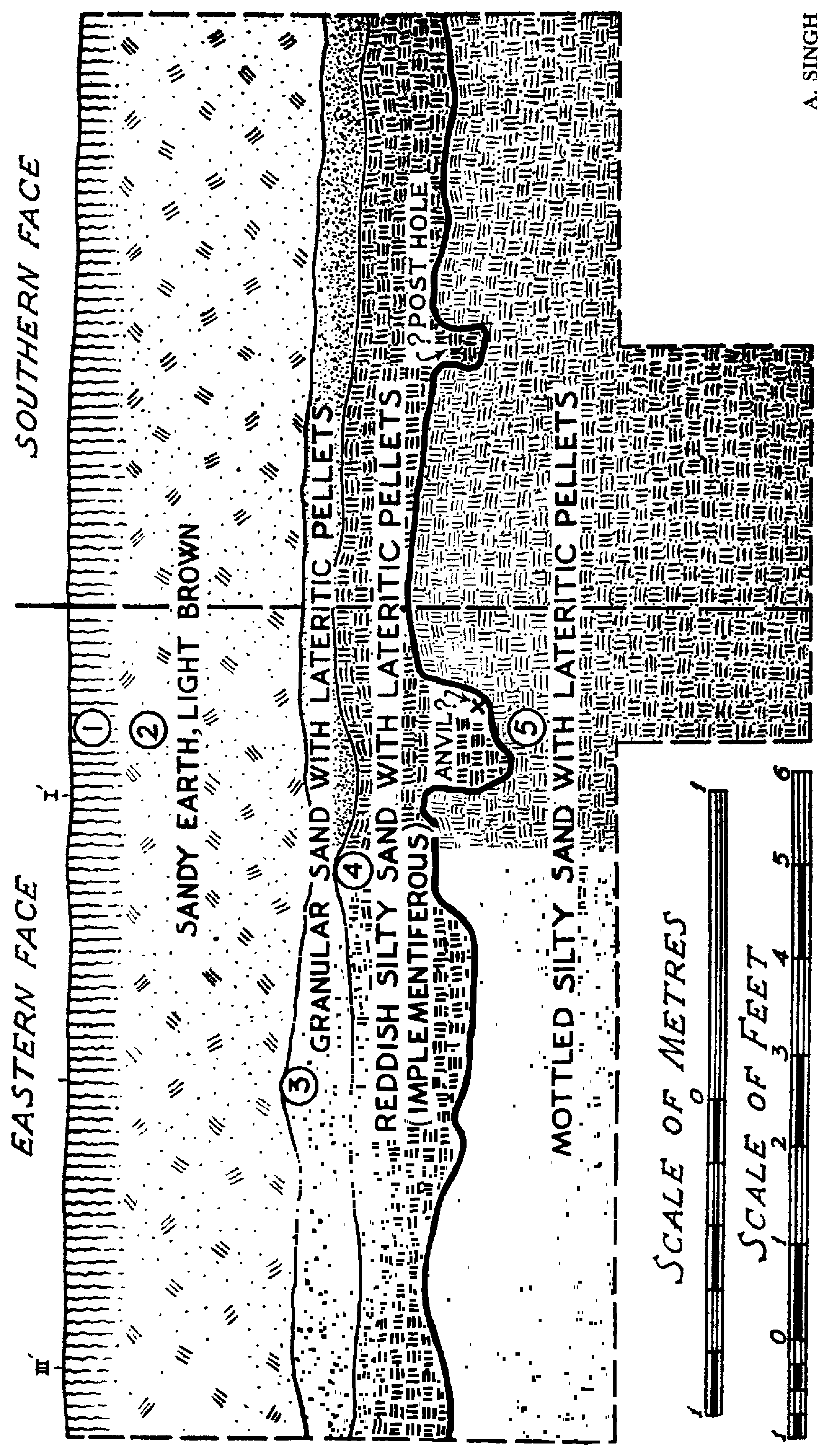


FIG. 5

depth of 6 ft. below the surface, whereafter deep digging was done in a limited space, 6×3 ft., in the Eastern Extension, reaching a total depth of 12½ ft. below the surface.

To come to the stratigraphy. Let it be stated first of all that even at a depth of 12½ ft. below the surface, the bed-rock was not encountered; and it would certainly be difficult, if not wrong, to guess as to how much lower it would be at this particular spot. However, observations made in the railway-cutting, about a hundred yards to the north-east, showed that the deposit overlying the bed-rock, viz. mottled silty sand, which was the same as layer 5 in Trench BBP-2 (fig. 5; pl. III), had a depth of about 12 ft. at the outside. This would suggest that in this Trench the bed-rock may be encountered within another few feet; at the same time the fact that the bed-rock had a slope towards the south i.e. roughly towards this Trench, may render the guess quite futile. Anyway, whatever the further depth at which the bed-rock is likely to be met with in this Trench, the main point is that it can be no other than the sandstone noticed in the railway-cutting on the north and in Trench BBP-1 and a few other exposures on the south.

It was from this sandstone that the mottled silty sand forming layer 5 was produced, as a result of long weathering (below, p. 47). Mixed with lateritic pellets, the silty sand showed distinct whitish and reddish patches (more of the former). In the lower levels, roughly between 10 and 12½ ft. below surface, whitish sand with streaks of black minerals was observed to be on the increase.

From layer 5 about a score of microlithic specimens were recovered. The maximum depth from which they came was 6 ft. 2 in. below the surface, i.e. within 2 ft. from the top of the layer. They did not occur all over the excavated area but were confined to a few spots, where, it was further observed, they lay in more or less vertical columns in what looked like fissures, subsequently filled up. From the small number of the specimens, which account for only about 3 per cent of the total yield, and from the sporadic way in which they occurred, it is evident that layer 5 was pre-microlithic, the microliths having infiltrated into it from the overlying implementiferous layer through fissures, which this kind of clay usually develops on exposure. Here it may also be noted that the top of layer 5 was undulating, having many humps and depressions.

It was on this kind of surface that the microlithic man settled. The deposit containing his tools, viz. layer 4, was again a silty sand mixed with lateritic pellets, basically not very much different from the upper part of the underlying layer, but distinguishable from the latter on account of its compactness and more reddish colour. The thickness of this layer ranged between 9 in. and 1 ft. 4 in., but no microliths were obtained from the top 4 to 5 in.

At a depth of 4 ft. 5 in. below the surface, in a pit measuring about 1¼ ft. in diameter and 9 in. to 1 ft. in depth (fig. 5), there occurred a piece of stone having some features which call for attention. Measuring about 6 in. in length, 4 in. across and 2 in. in thickness, it had a small, roughly rectangular depression on one side and a longitudinal ridge on the other, the surface in the depression being somewhat pitted (pl. IV B). It lay in association with a few microliths. While nothing can be said with certainty about the use of this stone, could it possibly have served as an anvil?[1]

Between the depths of 3 ft. 9 in. and 4 ft. from the surface about ten pits or holes, broadly falling under two sizes, were observed. In the case of the larger ones the diameter and depth varied respectively from 6 to 8 in. and 7 to 10 in., while in the smaller ones the

[1] In Trench BBP-1, a similar stone-fragment was found in association with a core of quartzite pebble, about a score of waste flakes and a couple of retouched tools (above, p. 11).

corresponding figures were 3 to 5 in. and 4 to 6 in. respectively. Put together, the holes did not make any clear-cut plan; if at all, the suggestion was more towards a roughly circular outline than towards one with straight sides and angles. No direct evidence—such as the presence of posts, etc.,—was obtained which could throw light on the use of these holes, and thus to think that they were 'post-holes' of a hut or wind-break would be nothing more than a conjecture. However, a point which may be of some interest in this context is that the supposed 'anvil' lay within the roughly circular, though incomplete, outline formed by the holes. But indeed much more evidence is necessary from Birbhanpur itself as well as from other comparable sites before anything positive can be said about these and other details of the life of the microlithic man.

It may be worth while to state here, even at the risk of repetition, that no pottery was found in association with the microliths.

Layer 3, which overlay the microlithic layer, consisted of granular sand mixed with lateritic pellets. It varied in thickness from 5 to 9 in. The succeeding layers, viz. 2 and 1, having a total thickness of 2½ ft., formed in fact a single deposit consisting of sandy earth. The two sub-divisions, however, were distinguished by their colours, the lower part, layer 2, being light-brown and the upper part, layer 1, being somewhat darker, evidently due to surface-vegetation. The deposit also showed signs of weathering.

Layers 3, 2 and 1 were completely devoid of microliths or other human artefacts.

4. THE CLUSTERS

The implementiferous terrace, T_{n-1}, has been eroded at several places on account of the flow of rain-water. Thus, in areas where the sandy earth, capping the terrace, has been completely washed away and the underlying reddish silty sand only slightly disturbed, microliths were encountered right on the surface. It was, however, observed that they occurred generally in clusters (pl. IV A), which were located at varying distances, say from 10 to 30 yards or even more, from one another. Owing to lack of time, a combined plan of these clusters could not be studied in detail; but perhaps it would be worth while to do so as it may throw some interesting light on the lay-out of the settlement.

Collections were made from five such clusters, numbered A to E, which lay within a furlong south of the Trench BBP-2. Some details regarding these clusters are as follows.[1]

Name of Cluster	*Approximate area*	*Number of microlithic specimens*
A	4½ × 3 ft.	154
B	6 × 6½ ft.	557
C	4 × 2¼ ft.	223
D	2¾ × 2½ ft.	112
E	12½ × 9½ ft.	1139

The percentage of various materials used in the manufacture of the microliths and the distribution of the tool-types in each cluster are given respectively in Tables 1 and 2 (below, pp. 17 and 33). A look at Table 2 would show that each cluster contained

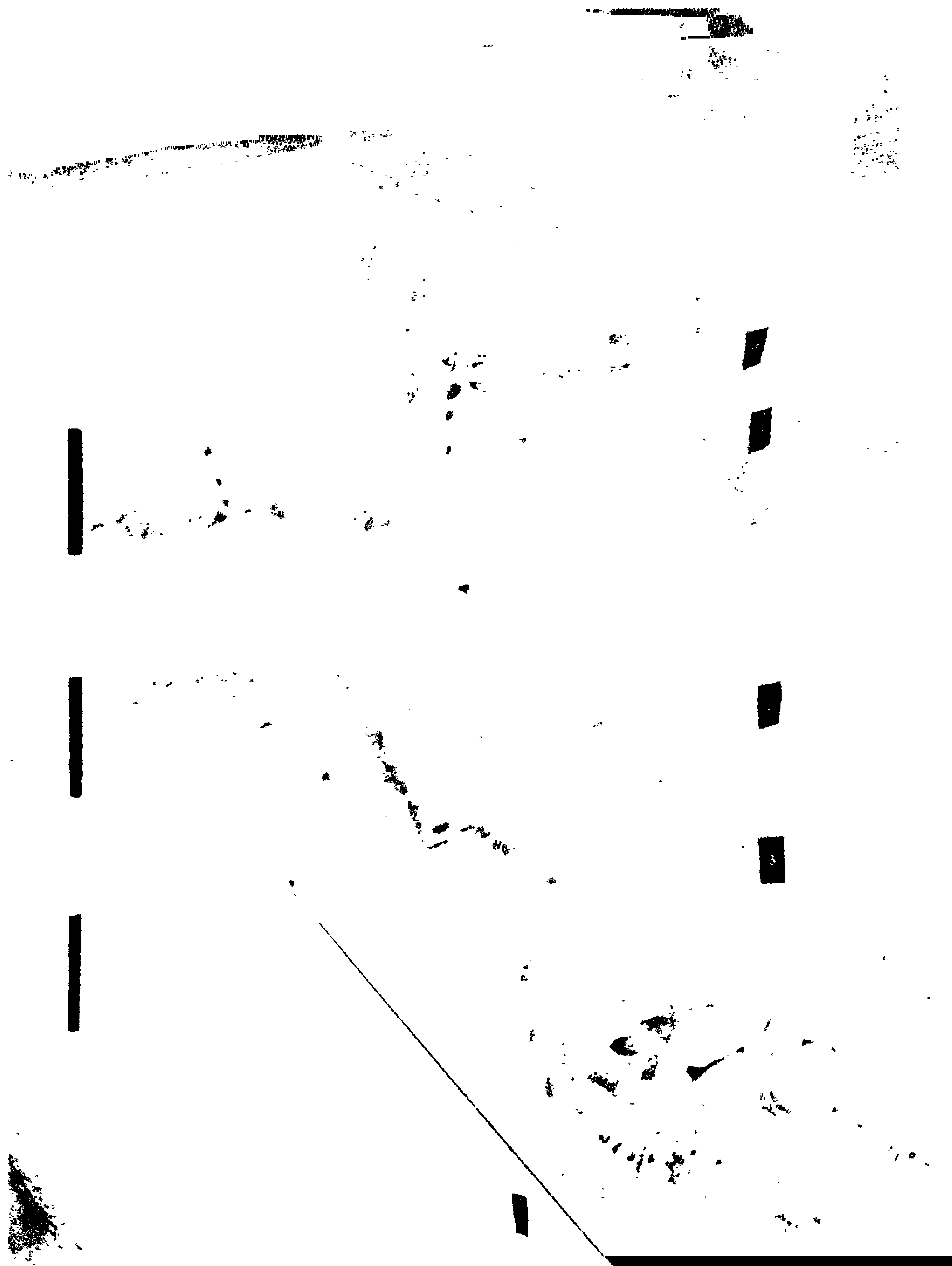
[1] In some of these clusters a few sherds of a reddish-brown ware were also obtained. But in view of the fact that no pottery was found in association with the microlithic industry in the exacavated trenches, it is clear that these sherds are of a later date; they evidently got mixed up with the microliths after the latter had been exposed as a result of the erosion of the covering soil.



Birbhanpur: general view of the microlithic site, looking south-west. In the foreground is seen Trench BBP-2 in its initial stages: in the right background, behind the houses, may be seen the Damodar river.

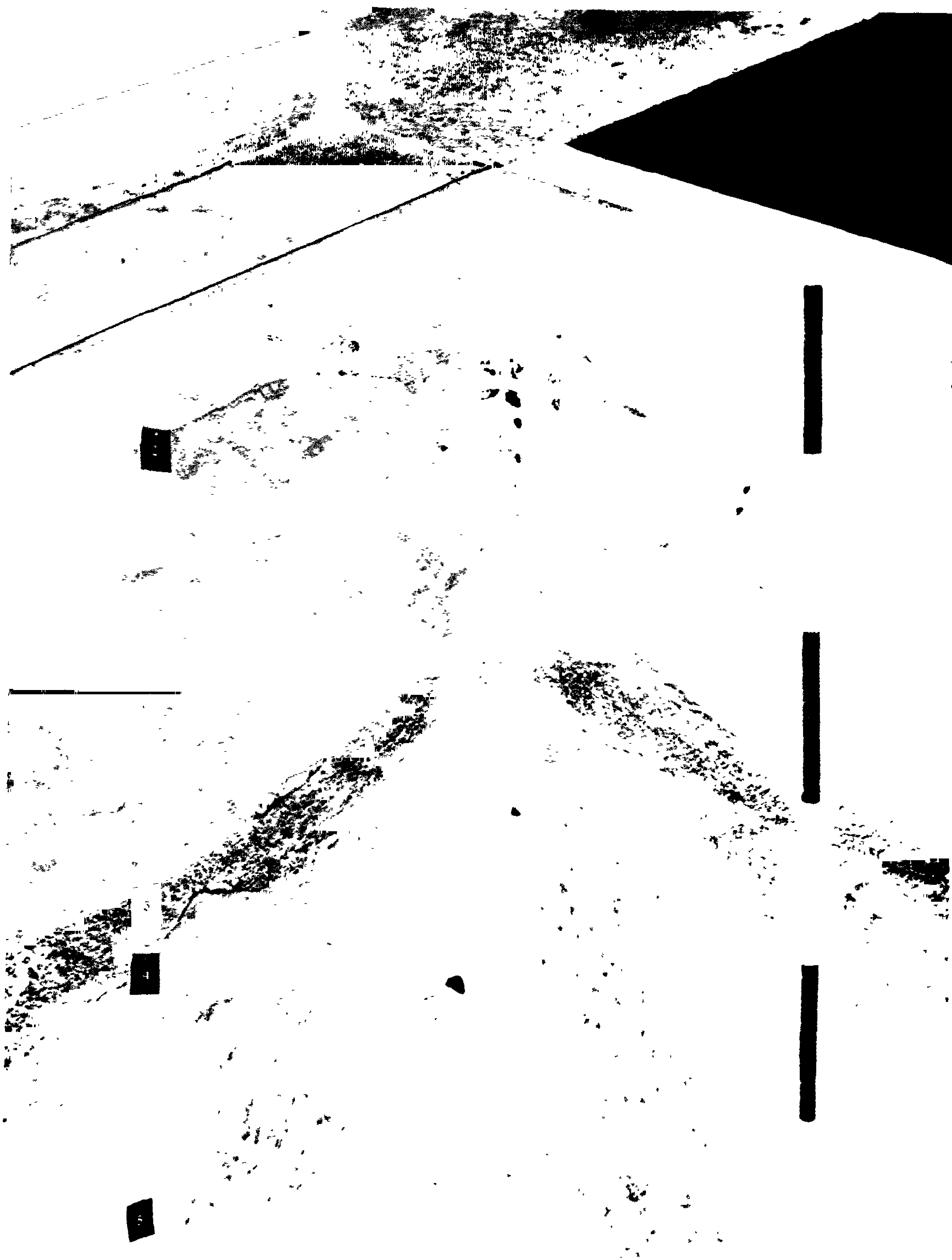
See page 7

To face p. 14



Birbhanpur: section of Trench BBP-1. Microliths were obtained from layer 2. *See page 9*

To face pl. III



Birbhanpur: section of Trench BBP-2. Microliths were obtained from layer 4. See pages 9 and 15

To face pl. II



A. *Birbhanpur: microliths lying about in Cluster B.* *See page 14*



B. *Birbhanpur: dorsal and ventral views of a stone anvil (?).* *See page 13*



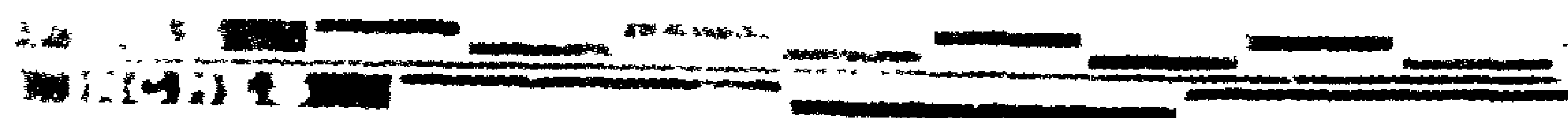
Birbhanpur: 1-10, cores; 11-12, core-rejuvenation flakes. *See pages 19 and 21*

1 2 3 4 5

6 7 8 9 10

11 12 13 14 15

16 17 18 19

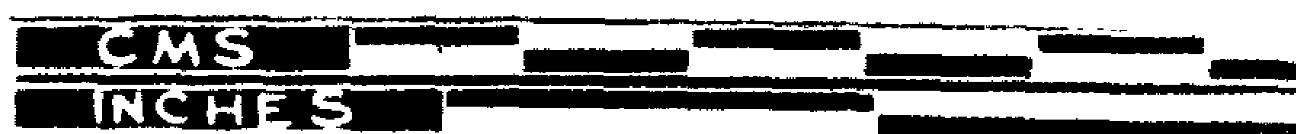


Birbhanpur: 1-15, blades on parallel-sided flakes; 16-19, blades on other flakes. *See page 21*

To face pl. VII

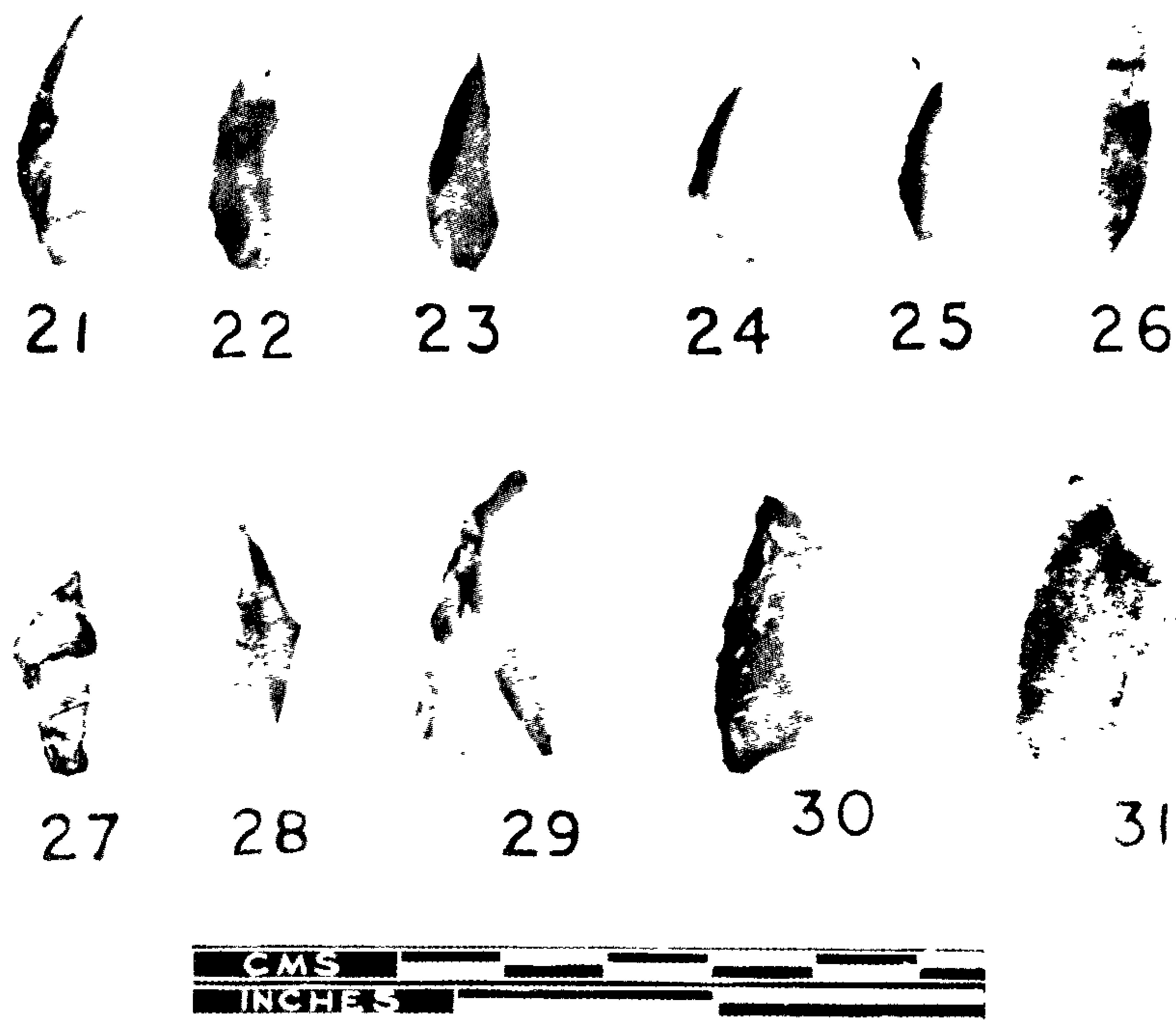


Birbhanpur: 1-18, lunates: 19, trapeze: 20, triangle ? . *See pages 23-25*



Birbhanpur: points. See page 25

To face pl. IX

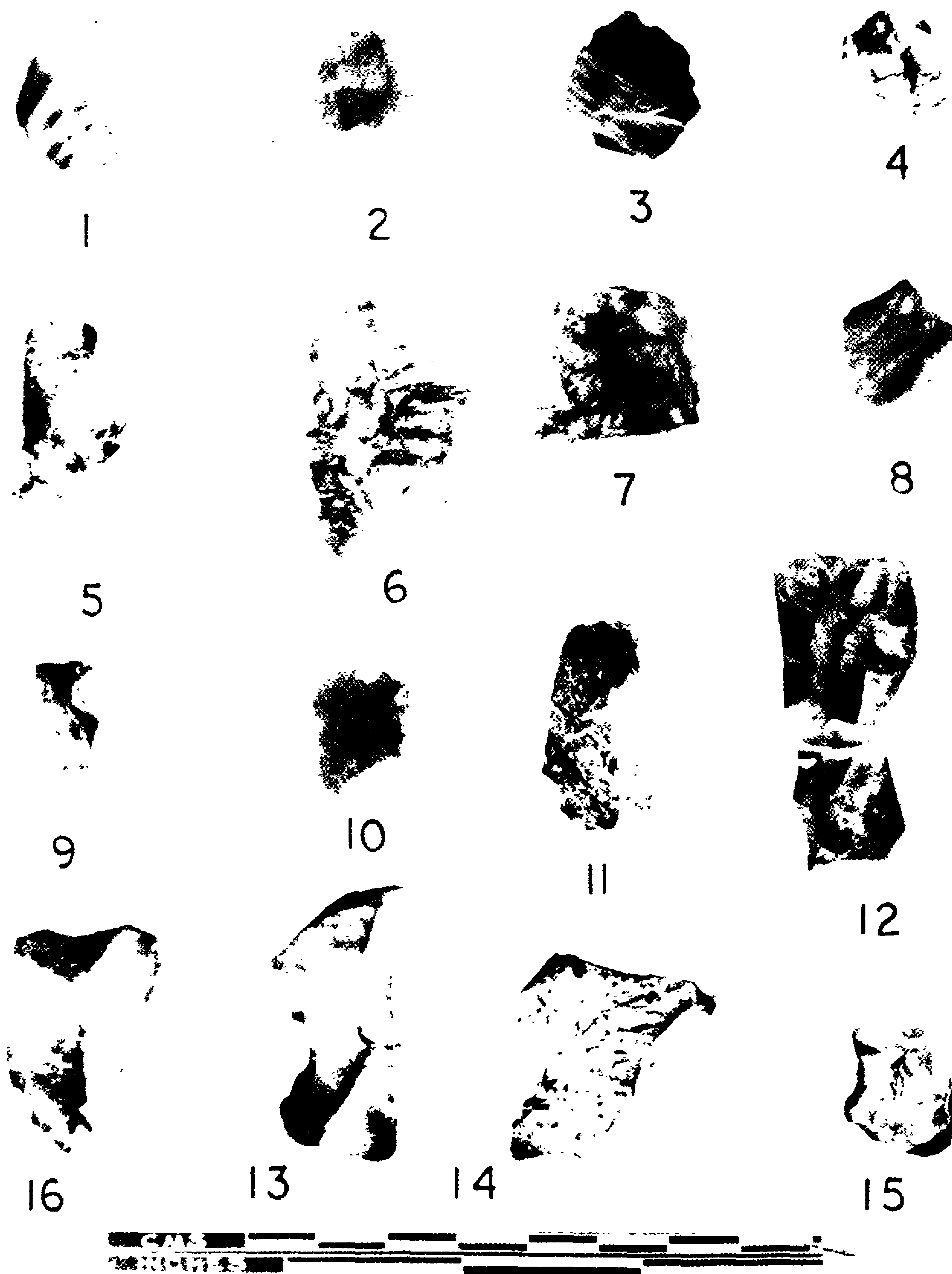


A. *Birbhanpur: points. See page 25*



B. *Birbhanpur: 1-5, borers; 6-9, burins. See pages 29 and 30*

To face pl. VIII



Birbhanpur: scrapers. See page 31

all the three items, viz. cores, waste flakes and finished tools, which would suggest that in all likelihood the clusters represent the actual spots where the tools were manufactured. Here it may not be out of place to mention that in one of the clusters a couple of small holes (? post-holes) were also noticed, but certainly more data are wanted before any satisfactory interpretation of the holes can be attempted.

5. THE MICROLITHIC INDUSTRY

A. General

The material discussed here comes from the two excavated Trenches, BBP-1 and BBP-2, as well as from the surface including that from Clusters A to E. Although there is no absolute evidence to prove that the entire material was contemporaneous, it appears fairly likely that it was so. The difference in the composition of the implementiferous layers of Trenches BBP-1 and BBP-2 may perhaps be explained by their respective locations, the former being on the slope of the terrace, T_{n-1}, and nearer the river and the latter being about 40 ft. higher and far away from the river (figs. 2 and 3; also pp. 11 and 13). However, as the sealing layer, viz. the sandy earth, is the same throughout, the microlithic material is anterior to it in both cases. Thus, the difference in time, if any, between the material from BBP-1 and that from BBP-2 may not be very much or, at least, of much consequence for the present study.

The material from the surface, however, is always open to a variety of interpretations. But as it is here found either embedded in the upper part of the mottled silty sand or overlying the same, and as the neighbouring undisturbed deposits indicate that the silty sand was originally sealed by the same sandy earth as encountered in the excavated Trenches, there is every likelihood that it is contemporary with that found in the Trenches. One cannot, however, ignore the possibility that some later material also could have got mixed up with it. Accordingly, while the entire material has been dealt with as constituting a single industry, in actual analysis care has been taken to check up whether or not a type available on the surface also occurs in the excavated Trenches and *vice versa*, and all cases of disagreement have been duly noted.

The microlithic industry, in a nutshell, may be regarded as pre-pottery in age and essentially non-geometric in character,[1] the chief raw material being quartz. These attributes are explained below one by one.

To take up the first. Although a kind of brownish ware is met with on the surface, for example in Clusters B, C and E, which may suggest the contemporaneity of the pottery with the microlithic industry, not a single sherd was found in the excavated Trenches, BBP-1 and BBP-2, in association with the microliths. In fact, even the sandy earth sealing the microlithic layer was found bereft of any pottery. It appears, therefore, that the pottery recovered from the surface originally overlay the sandy earth and, with the washing away of this deposit in the course of time, settled down and got mixed up with the underlying microliths which were exposed in the same denudational process. Thus, the co-occurrence of pottery and microliths on the surface cannot be taken as a proof of their contemporaneity.

[1] In this paper the term 'geometric' has been used to denote an industry wherein, besides blades, scrapers, burins, lunates, etc., typical geometric forms like triangles and trapezes occur in a substantial quantity. The occurrence of lunates alone is not considered sufficient to classify an industry as geometric.

One must depend in this respect entirely on the evidence from the excavation, which shows the non-existence of any pottery alongside the microlithic industry. It is admitted that the mere absence of pottery from the microlithic levels need not necessarily mean that the industry is pre-pottery. At the same time, as we are dealing here with an industry which, on geological and other grounds, seems to have a high antiquity (cf. pp. 34 ff.) and as we know from the evidence in other parts of the world that the art of making pottery features rather late in human progress, it is only reasonable to interpret the non-existence of pottery in the present case as suggesting that the microlithic industry under review is anterior to the use of pottery, at least in this region.

By the other attribute, namely that the industry is essentially non-geometric, it is intended to convey that typical geometric forms like the trapeze and triangle do not seem to form a noteworthy constituent of the industry. The position, however, is not absolutely clear but can be summarized as follows.

It may be stated at the outset that out of over four hundred finished tools recovered from the site there is only one specimen each of a trapeze and a triangle (fig. 8, *19* and *20*; pl. VII, *19* and *20*). In the latter case one is not even sure of its identification as a triangle, since at the back there are no clear-cut arms forming an apex at their junction; thus, it is not unlikely that the specimen may have been intended to be a lunate or a crescentic point. Further, both the specimens came from the surface, there being none from the excavation. Though no undue emphasis should be laid on the non-occurrence of the two types in the excavation as the excavated area was much smaller than the area from which surface-collections were made, yet the point is worth considering in view of the fact that trapezes and triangles do occur in a late microlithic industry represented at Nadiha,[1] hardly 1½ miles off. Again, the material used for the trapeze, viz. milky quartz, is more common at Nadiha, though it is not altogether absent from Birbhanpur. One is thus left wondering if the single trapeze found on the surface near Birbhanpur could have originally belonged to Nadiha from where it may have reached its present location through some agency in the past.

To sum up, whereas, on the one hand, it is not desirable to disregard even the single specimen of trapeze, on the other hand, it may also not be justified to claim on the basis of that single specimen of trapeze and the doubtful specimen of triangle that these two types formed a regular constituent of the microlithic industry of Birbhanpur. Thus, while the final assessment must await further exploration and excavation of the area, at the moment it appears reasonable to believe that the industry is essentially non-geometric.

The material used for the preparation of the tools includes quartz, rock-crystal (in varying degrees of crystallization), chert, chalcedony, quartzite, basalt and fossil-wood.[2] As would be seen from Table I (below, p. 17), quartz far outnumbers the rest, accounting for 68·7 per cent of the total. In the descending order of frequency come crystal, chert and chalcedony, representing respectively 16·1, 9·3 and 4·6 per cent of the total. Within the remaining 1 per cent are included quartzite, basalt and fossil-wood. Of these, particular interest attaches to the last-named material as its use for

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[1] Excavated by Shri T. N. Ramachandran. Material in the Indian Museum, Calcutta.

[2] Shri S. S. Ghosh, Senior Research Officer, Forest Research Institute, Dehra Dun, has sent the following preliminary note on the identification of the fossil-woods: 'The material examined revealed different kinds of dicotyledonous fossil-woods, amongst which *Anisoptera* of the *Dipterocarpaceae* family and *Acacia-Albizzia-Afzelia* and *Cynometra* of the *Leguminosae* family have been identified so far. However, for the preparation of the tools the fossil-woods belonging to the *Leguminosae* family seem to have been preferred, presumably because of their comparatively hard and fine texture'. See also S. S. Ghosh and M. H. Kazmi, '*Anisopteroxylon bengalensis* Gen. et sp. Nov.—new Fossil Wood from Microlithic Site of West Bengal', *Science and Culture*, XXIII (March, 1948), pp. 485-87.

making prehistoric tools has been reported so far from only one other site in India, viz. the *Teri* at Sawyerpuram.[1]

TABLE 1

ANALYSIS OF MATERIAL USED FOR THE BIRBHANPUR MICROLITHIC INDUSTRY

Locus \ Material	*Quartz*	*Crystal*	*Chert*	*Chalcedony*	*Quartzite*	*Fossil-wood*	*Basalt*	*Total*
Trench BBP-1 ...	1635 *61·7*	568 *21.4*	265 *10*	139 *5·2*	14 *·5*	23 *·8*	3 *·1*	2647
Trench BBP-2 ...	434 *72·9*	93 *15·6*	44 *7·3*	17 *2·8*	2 *·3*	5 *·8*	...	595
Cluster A (Surface) ...	95 *61·6*	26 *16·8*	14 *9*	18 *11·6*	1 *·6*	...	...	154
Cluster B (Surface) ...	390 *70*	90 *16·1*	41 *7·3*	36 *6·4*	...	...	...	557
Cluster C (Surface) ...	160 *71·7*	39 *17·4*	13 *5·8*	11 *4·9*	...	...	...	223
Cluster D (Surface) ...	65 *58*	3 *2·6*	38 *33·9*	6 *5·3*	...	...	...	112
Cluster E (Surface) ...	951 *83·4*	59 *5·1*	95 *8·3*	25 *2·1*	1 ...	8 *·7*	...	1139
Total ...	3730 *68·7*	878 *16·1*	510 *9·3*	252 *4·6*	18 *·3*	36 *·6*	3 ...	5427

Note: *No analysis is given here of other surface-collections as they are stray and consequently have little statistical value.*
The figures in italics represent percentage.

Quartz and crystal pebbles of varying sizes (up to about 2 in. in longer axis), readily available in the area, must have duly attracted the notice of the microlithic man. The other materials also occur within a few miles of the site, but the source of fossil-wood is not known.

Chert is frequently found patinated, and several specimens of this material as well as those of chalcedony have been noted to have a pitted surface. Though both these features may have been the result of long weathering, by themselves they may not mean much in assessing the antiquity of the industry.

Before closing the observations on the raw material it may be worth while to state that quartz and crystal seem to have been preferred to chert and chalcedony for the

[1] R. B. Foote, *The Foote Collection of Indian Prehistoric and Protohistoric Antiquities: Notes on their Ages and Distribution* (Madras, 1916), p. 50.

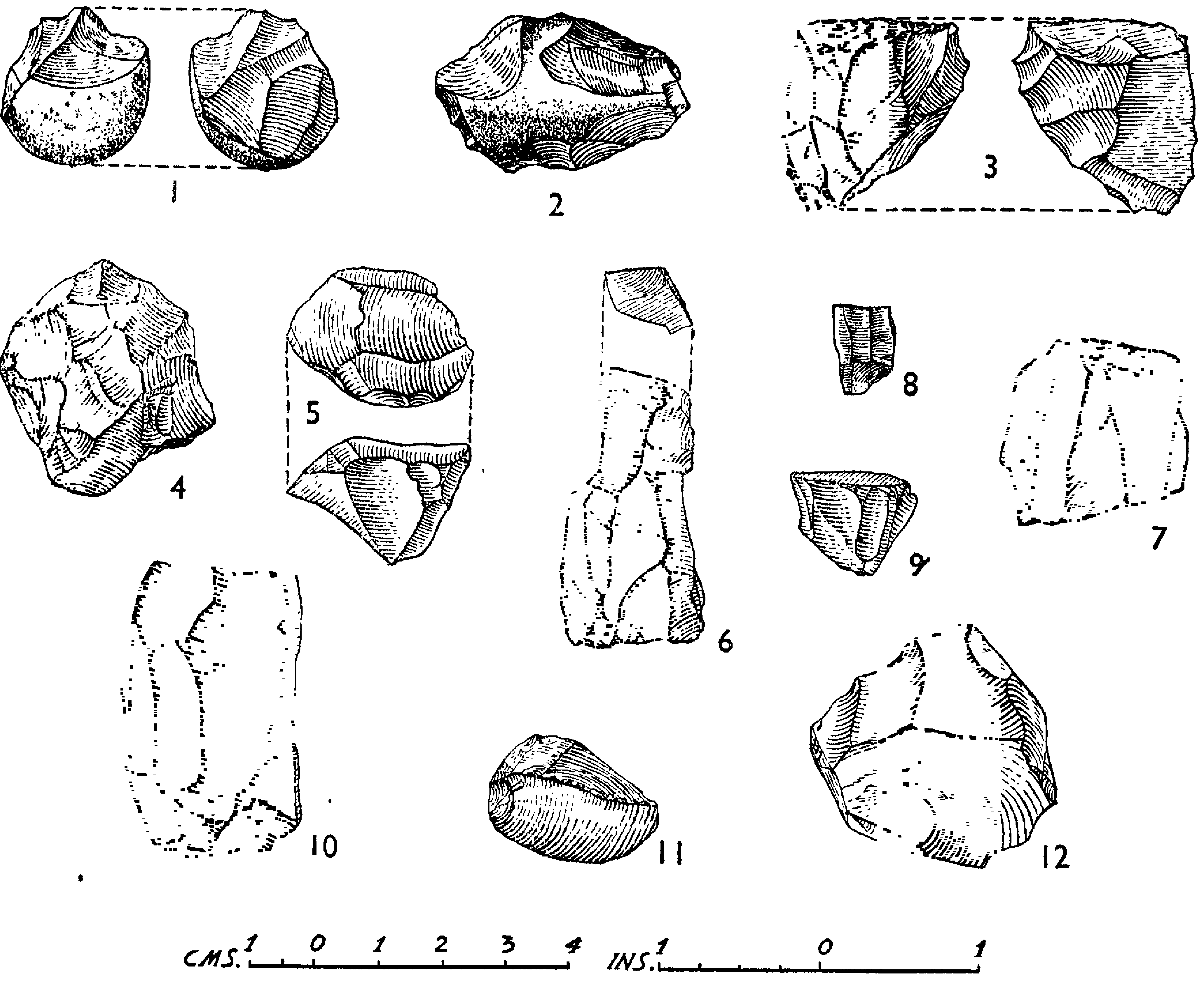


Fig. 6. *1-10, cores; 11 and 12, core-rejuvenation flakes*

preparation of borers and burins. For other tools, there does not seem to have been any bias for a particular material.

B. TYPOLOGICAL CLASSIFICATION AND DESCRIPTION OF ILLUSTRATED SPECIMENS

In saying that not a very satisfactory terminology exists in respect of the microlithic industries of the country, the author believes that he is also voicing the feelings of other workers in the field. To quote a few examples of this looseness in terminology, one finds that more or less the same kind of tool has been called variously 'awl', 'borer', 'piercer', 'perforator', etc. Similarly, without any apparent basis, different adjectives like 'notched', 'hollow' or 'concave' have been used to denote the same variety of scraper. The terms 'lunate' and 'crescent' have been frequently interchanged and no distinction has been made between a lunate, which is usually symmetrical along the shorter axis, and a crescentic point, which is mostly asymmetrical and in which the point is the more important feature. The present occasion may, therefore, be utilized for attempting a rationalization of nomenclature and classification in the hope that with further suggestions from co-workers a more rational terminology may come into being one day.[1]

The following typological classification is proposed for the Birbhanpur microlithic industry. The number of types and sub-types may have to be enlarged in the course of time when additional material, not covered by the categories enumerated here, is obtained from the site itself. Similarly, for applying this classification to other microlithic industries of the country many more additions may have to be made as some of the types may be completely absent from Birbhanpur. Thus, what is suggested here is merely a kind of general framework which may be enlarged and modified according to the needs of the situation.

(i) *Type A: cores* (fig. 6, *1-10*; pl. V, *1-10*)

The cores are divisible into the following two sub-types.

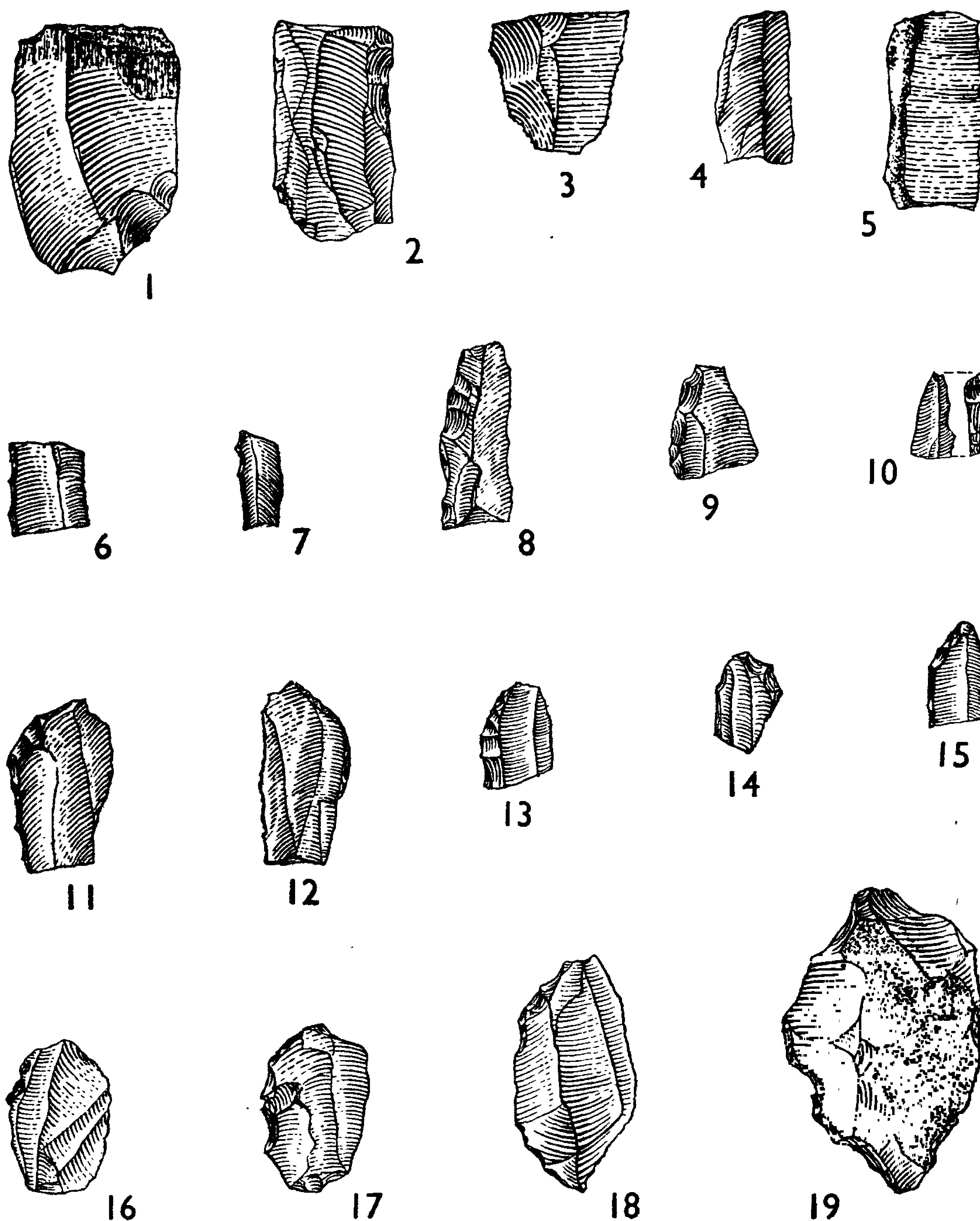
Sub-type Ai (fig. 6, *1-5*; pl. V, *1-5*) is an ordinary core not specially prepared to produce flakes of a pre-determined shape, which is in contrast to what happens in sub-type Aii, below. Thus, free-flaking is commonly resorted to in this case, the flakes being detached from one, two or even more sides. Sometimes the platform is also prepared to produce Levalloisean flakes, but the flakes, whether Levalloisean or otherwise, are usually of an irregular shape—ovoid, roundish, leaf-like, etc., and not parallel-sided.

Sub-type Aii (fig. 6, *6-10*; pl. V, *6-10*) is a fluted core, specially dressed to produce parallel-sided flakes, which may be struck from a single platform or from two platforms, either opposed or at right angles to each other. There are also cases with even more than two platforms. In shape, these cores appear either conical or cylindrical.

The following specimens, representing the two sub-types of cores, are illustrated (fig. 6; pl. V).

1. Core, sub-type Ai; quartz. Flakes taken out from both dorsal and ventral surfaces of the pebble. (BBP-1, 126.)

[1] Here the author wishes to express his thanks to Dr. B. Subbarao, who not only made available for a comparative study his collections of microliths from Gujarat but also gave his valuable suggestions in respect of the classification put forward in this paper.



CMS. 1 0 1 2 3 4 INS. 1 0 1

FIG. 7. *1-15, blades on parallel-sided flakes; 16-19, blades on other flakes*

2. Core, sub-type Ai; quartzite. In this case also flakes removed from both the surfaces. (BBP-1, 127.)

3. Core, sub-type Ai; chert. Flakes removed not only from the prepared platform at the top but also along one of the edges which is roughly transverse to the platform. (BBP-Sf[1], 66.)

4. Core, sub-type Ai; chert. Flakes removed from all over the surface. (BBP-Sf, 67).

5. Core, sub-type Ai; chert. Flakes removed from all over the surface in such a way that the remainder roughly resembles a cone. (BBP-1, 128.)

6. Core, sub-type Aii; chert. Flakes removed from both the ends. (BBP-Sf, 68.)

7. Core, type Aii; chert. Flakes removed from both the ends. (BBP-Sf, 69.)

8. Core, sub-type Aii; crystal. Flakes removed mostly from one end. (BBP-1, 129.)

9. Core, sub-type Aii; chert. Flakes removed mostly from one end in such a way that the remainder roughly resembles a cone. (BBP-Sf, 70.)

10. Core, sub-type Aii; chert. Flakes removed not only from the two opposing ends but also transversely from one of the sides. (BBP-Sf, 71.)

(ii) *Type B: flakes* (fig. 6, *11* and *12*; pl. V, *11* and *12*)

Following the cores, the flakes also fall under two main sub-types.

To *sub-type Bi* belong the ordinary flakes with varying shapes—ovoid, roundish, leaf-like, etc. They are usually broad as opposed to the parallel-sided flakes which are longish. Though generally struck freely from the core, sometimes they also bear traces of a prepared platform, recalling the Levalloisean technique.

Sub-type Bii comprises more or less parallel-sided flakes, which are struck from specially prepared cores of sub-type Aii. Though the flakes are longish, in contrast to those of sub-type Bi, their length usually falls within $1\frac{1}{3}$ in., the exceptions being few and far between. It may perhaps be mentioned pointedly that long ribbon-flakes as well as flakes with crested ridge, associated with the Harappa and other chalcolithic cultures of the country, are absent from the Birbhanpur industry.

From these two sub-types may be distinguished a third kind of flakes, *sub-type Biii* (fig. 6, *11* and *12*; pl. V, *11* and *12*), which is struck from the core to 'rejuvenate' the striking platform. This 'core-rejuvenation flake', as it is called, may be a small one if the platform is to be improved only sightly or it may be even a sizable 'tablet' in the form of a rough cylinder or cone if the platform is to be completely renewed.

Flakes of sub-types Bi and Bii are not illustrated, there being no outstanding feature about them. Only core-rejuvenation flakes or tablets, belonging to sub-type Biii, are illustrated (fig. 6; pl. V).

11. Flake, sub-type Biii; chert. (BBP-Sf, 72.)

12. Flake, sub-type Biii; chert. (BBP-Sf, 73.)

(iii) *Type C: blades* (fig. 7; pl. VI)

Within this category are included tools which may have functioned as blades, irrespective of the type of flakes, parallel-sided or otherwise, used for their preparation. The following sub-types are distinguished.

[1]Sf is an abbreviation of 'surface', used to denote surface-finds.

Sub-type Ci (fig. 7, *1-5*; pl. VI, *1-5*) refers to more or less parallel-sided flakes with the distal end usually snapped and the proximal end sometimes rounded off by secondary working. Neither of the two edges is blunted, although in a few specimens (e.g. fig. 7, *5*; pl. VI, *5*) the presence of a high ridge nearer one of the edges provides a kind of 'back'. One of or both the edges may show use-marks.

Sub-type Cii (fig. 7, *6-10*; pl. VI, *6-10*) is again made on more or less parallel-sided flakes, of which one edge is blunted, presumably for hafting. The blunted edge ('back') may or may not be parallel to the cutting ege, but it forms a straight line. The distal end usually and the proximal end quite often are snapped.

Sub-type Ciii (fig. 7, *11-15*; pl. VI, *11-15*) differs from sub-type Cii in so far as the blunted side does not form a straight line but is partly straight and partly curved or oblique.

Sub-type Civ (fig. 7, *16-19*; pl. VI, *16-19*) is made on ovoid or leaf-shaped flakes as against parallel-sided flakes, one of the sides being entirely or partly blunted.

The following specimens, representing the four sub-types of blades, are illustrated (fig. 7, pl. VI).

1. Blade, sub-type Ci; fossil-wood. Bulb of percussion on the ventral surface and a few flake-scars on the dorsal surface near proximal end clearly identifiable; distal end trimmed straight. (BBP-Sf, 1.)

2. Blade, sub-type Ci; chert. Proximal end slightly retouched; distal end snapped; right edge bears use-marks. (BBP-Sf, 2.)

3. Blade, sub-type Ci; chert. Distal end snapped; both edges bear use-marks. (BBP-1, 1.)

4. Blade, sub-type Ci; chert. Both ends snapped. (BBP-1, 2.)

5. Blade, sub-type Ci; chalcedony. Ridge on dorsal surface is nearer left edge, whereby a kind of 'back' is formed without any retouch; right edge bears use-marks. (BBP-Sf, 3.)

6. Blade, sub-type Cii; chert. Both ends snapped; left edge steeply blunted, right bears use-marks. (BBP-Sf, 4.)

7. Blade, sub-type Cii; chert. Both ends snapped; left edge steeply blunted. (BBP-1, 3.)

8. Blade, sub-type Cii; chert. Upper end snapped, lower retouched; left edge blunted with oblique retouches. (BBP-Sf, 5.)

9. Blade, sub-type Cii; quartz. Both ends snapped; left edge steeply blunted. (BBP-1, 4.)

10. Blade, sub-type Cii; chert. Lower end snapped; right edge steeply blunted. (BBP-Sf, 6.)

11. Blade, sub-type Ciii; chert. Left edge blunted, being partly straight and partly curved; lower end snapped. (BBP-Sf, 7.)

12. Blade, sub-type Ciii, quartz. Right edge blunted, being partly straight and partly curved; left edge bears use-marks; lower end snapped. (BBP-Sf, 8.)

13. Blade, sub-type Ciii; quartz. Left edge blunted, being partly straight and partly curved; lower end snapped. (BBP-2, 1.)

14. Blade, sub-type Ciii; crystal. Right edge blunted, being partly straight and partly curved; lower end snapped. (BBP-2, 2.)

15. Blade, sub-type Ciii; chert. Left edge blunted, being partly straight and partly oblique; lower end snapped. (BBP-2, 3.)

16. Blade, sub-type Civ; quartz. Made on leaf-shaped flake; left side steeply blunted, right bears use-marks. (BBP-1, 5.)

17. Blade, sub-type Civ; quartz. Made on leaf-shaped flake; left side steeply blunted. (BBP-Sf, 9.)

18. Blade, sub-type Civ; chert. Made on leaf-shaped flake; left side partly blunted, right bears use-marks. (BBP-Sf, 10.)

19. Blade, sub-type Civ; chert. Made on leaf-shaped flake; left side partly blunted, right bears use-marks. (BBP-Sf, 11.)

(iv) *Type D: lunates* (fig. 8, *1-18*; pl. VII, *1-18*)

Of the lunates, four sub-types are differentiated as follows.

In *sub-type Di* (fig. 8, *1-5*; pl. VII, *1-5*) the blunted back forms an arc which is more or less symmetrical along the shorter axis of the tool. Further, the breadth is usually less than half the length, which feature stands in marked contrast to what happens in sub-type Diii, below.

Sub-type Dii (fig. 8, *6-10*; pl. VII, *6-10*) closely follows the former but for the difference that the dorsal side has no ridges. Thus, both dorsal and ventral sides have each single-flake surface. Although the difference between these two sub-types may not be of much essence, yet a distinction has been made as the feature that both the dorsal and ventral surfaces are ridgeless does strike the eye.

Sub-type Diii (fig. 8, *11-15*; pl. VII, *11-15*) is quite distinct from the above sub-types. In it the back bulges out in a rather elliptical form and the ends have a tendency to flare out. Further, the breadth is usually more than half the length. In some of the specimens (e.g. fig. 8, *13*; pl. VII, *13*) a flake is removed from the upper surface of the bulged portion of the back, presumably to improve it for hafting. Quite often has this sub-type been called a 'transverse arrow-head', though the typical transverse blow is wanting.

In *sub-type Div* (fig. 8, *16-18*; pl. VII, *16-18*) it is the chord and not the arc that is blunted. This is done generally by secondary working but sometimes even by mere snapping. Quite often secondary work is also done along the arc in order to sharpen it further. Attention may also be drawn to an incipient 'tang'-like projection at the bottom.

The following specimens, representing the four sub-types of lunates, are illustrated (fig. 8; pl. VII).

1. Lunate, sub-type Di; chert. Arc blunted; chord bears use-marks. (BBP-Sf, 12.)
2. Lunate, sub-type Di; crystal. Arc steeply blunted. (BBP-Sf, 13.)
3. Lunate, sub-type Di; quartz. Arc steeply blunted. (BBP-1, 39.)
4. Lunate, sub-type Di; chert. Arc steeply blunted, chord bears use-marks. (BBP-Sf, 14.)
5. Lunate, sub-type Di; chert. Arc steeply blunted except for the middle portion which is not retouched; chord bears use-marks. (BBP-Sf, 15.)
6. Lunate, sub-type Dii; chert. Arc blunted; both dorsal and ventral sides have single-flake surface. (BBP-Sf, 16.)
7. Lunate, sub-type Dii; chert. Arc blunted; chord bears use-marks; both dorsal and ventral sides have single-flake surface. (BBP-Sf, 17.)
8. Lunate, sub-type Dii; chert. Arc blunted; both dorsal and ventral sides have single-flake surface; chord bears use-marks. (BBP-1, 40.)
9. Lunate, sub-type Dii; chert. Arc steeply blunted; both dorsal and ventral sides have single-flake surface. (BBP-Sf, 18.)
10. Lunate, sub-type Dii; chert. Arc blunted; an additional flake removed from the dorsal surface, maybe to do away with some small ridge that may have existed. (BBP-1, 41.)

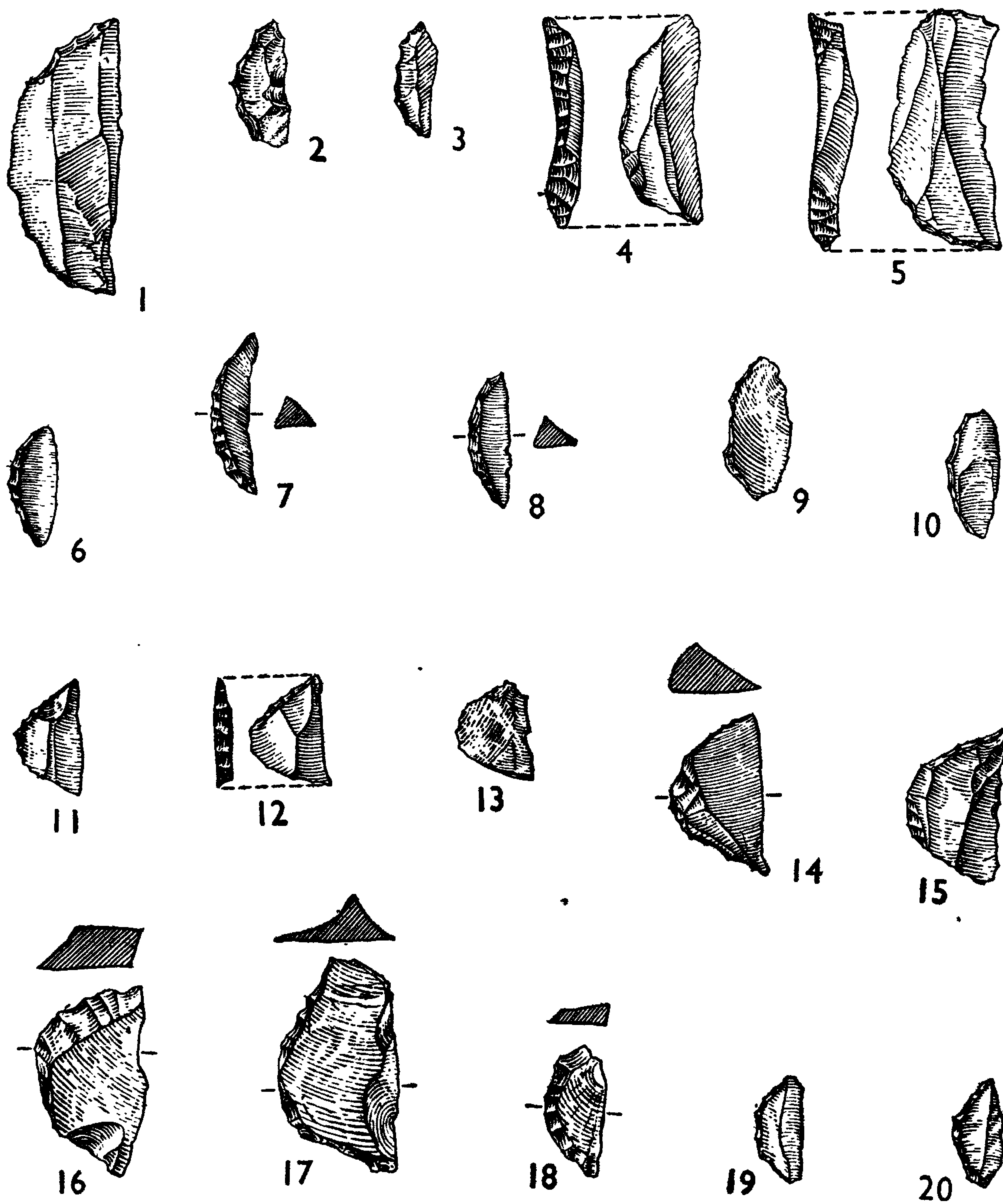


FIG. 8. *1-18, lunates; 19, trapeze; 20, triangle (?)*

11. Lunate, sub-type Diii; chert. Steeply blunted back bulges out in a rather elliptical form; ends have a tendency to flare out. (BBP-Sf, 19.)

12. Lunate, sub-type Diii; chert. Steeply blunted back bulges out in an elliptical form; ends have a tendency to flare out; chord bears use-marks. (BBP-2, 20.)

13. Lunate, sub-type Diii; crystal. Blunted back bulges out in an elliptical form; further, a small flake is removed from the upper surface of the bulged portion, presumably to improve it for hafting. (BBP-Sf, 20.)

14. Lunate, sub-type Diii; chert. Steeply blunted back bulges out in a rather elliptical form; lower end has a tendency to flare out. (BBP-2, 21.)

15. Lunate, sub-type Diii; chert. Back steeply retouched, except for the bulged (middle) portion; chord bears use-marks. (BBP-Sf, 21.)

16. Lunate, sub-type Div; crystal. Chord snapped and slightly retouched; arc sharpened by removal of small flakes. (BBP-Sf, 22.)

17. Lunate, sub-type Div; crystal. Chord blunted; arc sharpened by removal of small flakes; there is also an incipient tang at the lower end. (BBP-Sf, 23.)

18. Lunate, sub-type Div; crystal. Chord blunted; arc sharpened by removal of small flakes; there is also an incipient tang at the lower end. (BBP-Sf, 24.)

(v) *Type E: trapeze* (fig. 8, *19*; pl. VII, *19*)

Of the trapeze, only one example, of milky quartz, has been found. It comes from the surface, there being none from the excavation (BBP-Sf, 25).

As discussed above (p. 16), it is difficult to say whether the type formed a regular constituent of the Birbhanpur microlithic industry.

(vi) *Type F: triangle* (fig. 8, *20*; pl. VII, *20*)

There is only one specimen, of chalcedony, in the entire collection which has any resemblance to a triangle, though no clear 'angle' is formed at the back. It is equally likely that the specimen may be just a crescentic point (BBP-Sf, 26).

(vii) *Type G: points* (figs. 9 and 10; pls. VIII and IX A)

The points are divisible into the following sub-types.

Sub-type Gi (fig. 9, *1* and *2*; pl. VIII, *1* and *2*) is an ordinary (i.e. not parallel-sided) flake with a pointed tip. It has no secondary working except for the removal of one or two small flakes from the upper surface at the butt-end so as to produce a notch or tang for hafting. There are, however, definite marks of use.

Sub-type Gii (fig. 9, *3-6*; pl. VIII, *3-6*) is a broad,[1] roughly symmetrical, leaf-shaped point, made on an ordinary (not parallel-sided) flake. A small flake is sometimes removed from the upper surface at the butt-end to facilitate hafting.

Sub-type Giii (fig. 9, *7* and *8*; pl. VIII, *7* and *8*) is a variant of the above with a hollow base.

[1]The terms 'broad' and 'long' have been used to indicate the relationship between the breadth and length of a specimen. Thus, the term 'broad' refers to a specimen the breadth of which is more than half its length, and the term 'long' to a specimen where this is not so.

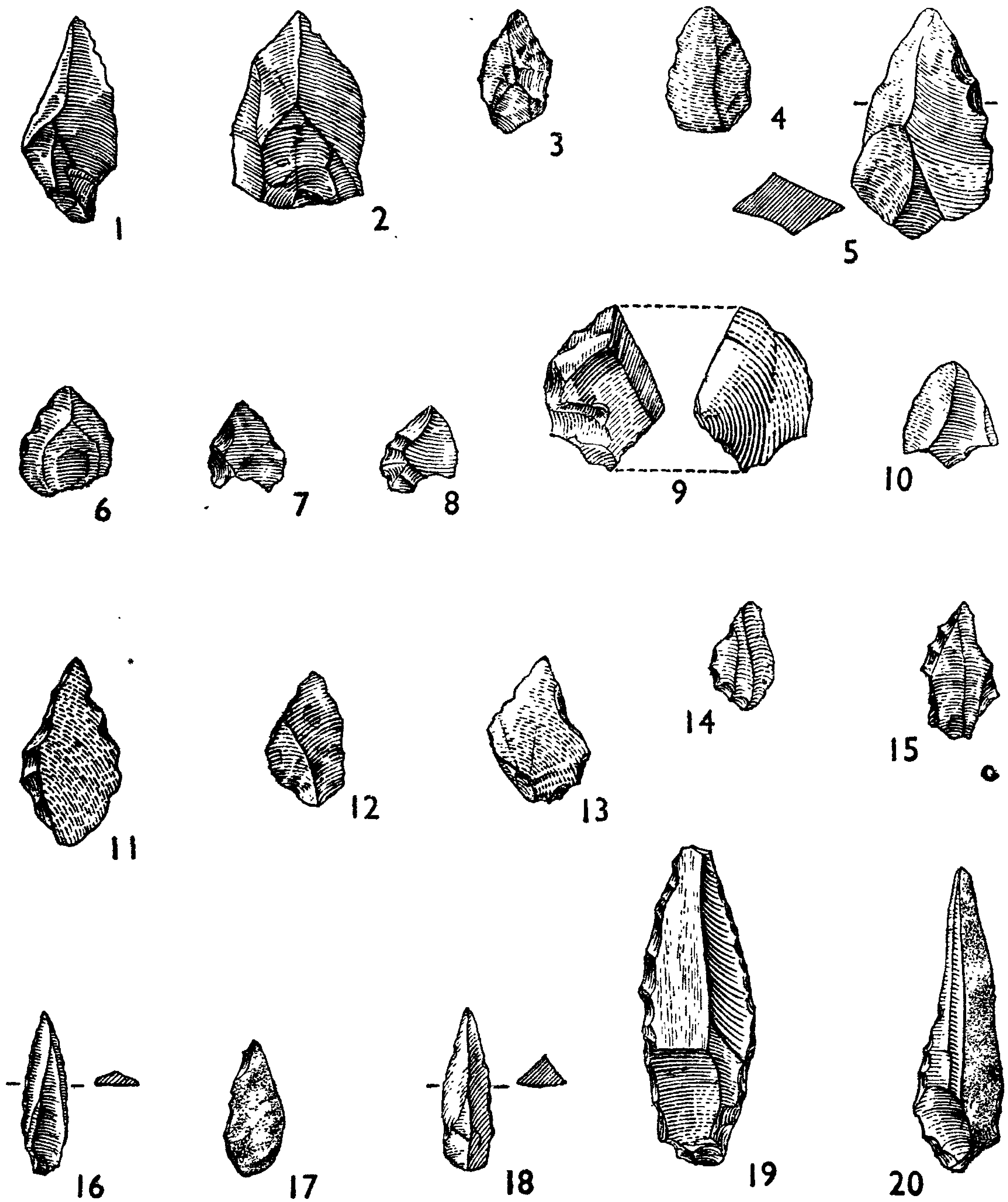


Fig. 9. *Points*

Sub-type Giv (fig. 9, *9* and *10*; pl. VIII, *9* and *10*) is also a variant of sub-type Gii with a tang which, however, is not very prominent.

Sub-type Gv (fig. 9, *11-15*; pl. VIII, *11-15*) differs from sub-type Gii in being asymmetrical, though like the latter it is broad and made on an ordinary flake.

In contrast to the foregoing, the following sub-types, viz. Gvi to Gxi, are made on more or less parallel-sided flakes and are long.

Of sub-type Gvi (fig. 9, *16-19*; pl. VIII, *16-19*), both the edges are trimmed, usually along the entire length, in a way as to produce a biconvex outline with a narrow butt, somewhat wider middle portion and a sharp point.

Sub-type Gvii (fig. 9, *20*; pl. VIII, *20*) differs from the former in having a tang.

Sub-type Gviii (fig. 10, *21-23*; pl. IX A, *21-23*) is a 'crescentic' point. In it one edge remains more or less untrimmed and straight, while the other is blunted so as to form an arc which, however, is *not* symmetrical along the shorter axis of the tool. It is this latter feature that distinguishes the crescentic point from the lunate, sub-type Di (above, p. 23). The asymmetry is evidently deliberate, for thereby one end is made pointed, while the other remains wide for hafting. Sometimes a notch is also produced at the wider end in order to improve hafting.

Sub-type Gix (fig. 10, *24-26*; pl. IX A, *24-26*) closely follows the former but for the difference that the dorsal surface has no ridges. (The distinction between these two sub-types is on the same lines as that between sub-types Di and Dii of the lunate.)

Sub-type Gx (fig. 10, *27* and *28*; pl. IX A, *27* and *28*) is an 'obliquely blunted' point. In it one edge remains more or less straight, while the other is retouched along the entire length or part thereof in a way that two 'arms' are produced on this side, the upper being shorter and more oblique and ending in a point. The trimming of the lower portion is evidently to improve hafting.

Sub-type Gxi (fig. 10, *29-31*; pl. IX A, *29-31*) is in all likelihood a composite tool, serving both as a point and a blade. The non-blunted edge bears use-marks showing its use as a blade, while the blunted side, forming a rough curve, ends in a beak-like point. The base, in contrast to that of the preceding type, is wide and blunted.

The following specimens, representing the aforesaid sub-types of points, are illustrated (figs. 9 and 10; pl. VIII and IX A).

1. Point, sub-type Gi; chert. Flake with pointed tip; at the butt-end a few tiny flakes removed to produce some sort of a tang. (BBP-Sf, 27.)

2. Point, sub-type Gi; chert. Flake with pointed tip. A couple of small flakes removed from the upper surface at the butt-end producing thereby a notch for hafting. (BBP-Sf, 28.)

3. Point, sub-type Gii; crystal. Broad, symmetrical, leaf-shaped with retouch along the edges as needed to obtain the shape. (BBP-Sf, 29.)

4. Point, sub-type Gii; quartzite. Broad, symmetrical, leaf-shaped. (BBP-1, 56.)

5. Point, sub-type Gii; quartz. Made on core; broad, symmetrical, leaf-shaped; notch at the butt-end. (BBP-1, 57.)

6. Point, sub-type Gii; quartz. Broad, symmetrical, leaf-shaped; notch at butt-end. (BBP-1, 58.)

7. Point, sub-type Giii; quartz. Broad, symmetrical, leaf-shaped, hollow-based. (BBP-1, 59.)

8. Point, sub-type Giii; chert. Broad, symmetrical, leaf-shaped, hollow-based. (BBP-1, 60.)

9. Point, sub-type Giv; chert. Broad, symmetrical, leaf-shaped; tang produced by retouching both the edges at the butt-end. (BBP-Sf, 30.)

10. Point, sub-type Giv; chert. Broad, symmetrical, leaf-shaped; tang produced by means of a notch on each side at the butt-end. (BBP-Sf, 31.)

11. Point, sub-type Gv; basalt. Broad and leaf-shaped, but asymmetrical in contrast to the foregoing sub-types; clear retouch all along both the edges. (BBP-Sf, 32.)

12. Point, sub-type Gv; crystal. Broad, asymmetrical, leaf-shaped; prominent retouch along the left edge. (BBP-Sf, 33.)

13. Point, sub-type Gv; quartz. Broad, asymmetrical, leaf-shaped. (BBP-1, 61.)

14. Point, sub-type Gv; quartz. Broad, asymmetrical leaf-shaped. (BBP-1, 62.)

15. Point, sub-type Gv; crystal. Broad, asymmetrical, leaf-shaped; broad tang produced by slightly retouching the butt-end. (BBP-1, 63.)

16. Point, sub-type Gvi; chert. Long, symmetrical, biconvex. (BBP-Sf, 33.)

17. Point, sub-type Gvi; quartz. Long, symmetrical, biconvex. (BBP-1, 64.)

18. Point, sub-type Gvi; chert. Long, symmetrical, biconvex. (BBP-Sf, 34.)

19. Point, sub-type Gvi; fossil-wood. Long, symmetrical, biconvex. (BBP-Sf, 35.)

20. Point, sub-type Gvii; chert. Long, more or less symmetrical and biconvex; tang produced by retouching both the edges at the butt-end. (BBP-Sf, 36.)

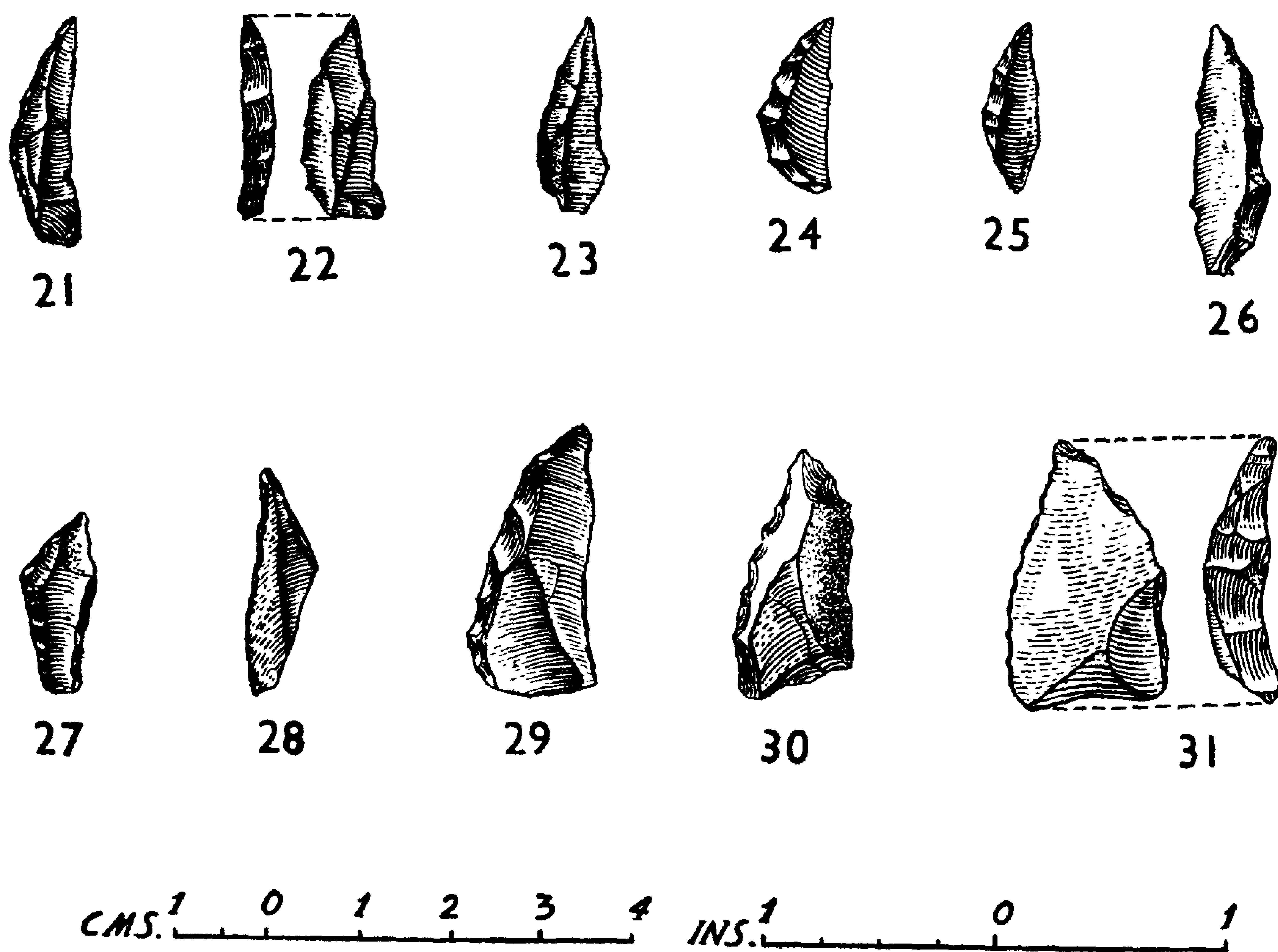


Fig. 10. *Points*

21. Point, sub-type Gviii; chert. One edge straight, the other blunted so as to form an arc which, however, is not symmetrical along the shorter axis of the tool; thus, upper end pointed; lower broad, evidently for hafting. To give a short name to this sub-type, the term 'crescentic' point has been provisionally used here. (BBP-Sf, 38.)

22. Point, sub-type Gviii; quartz. 'Crescentic'; back steeply blunted; small notch near butt-end. (BBP-1, 66.)

23. Point, sub-type Gviii; chert. 'Crescentic'; very sharp point. (BBP-Sf, 39.)

24. Point, sub-type Gix; chert. 'Crescentic'; differentiated from the preceding sub-type by the absence of any ridge on the upper side; thus, both dorsal and ventral sides have single-flake surfaces. (BBP-Sf, 40.)

25. Point, sub-type Gix; chert. 'Crescentic'; both dorsal and ventral sides have single-flake surfaces. (BBP-2, 27.)

26. Point, sub-type Gix; chert. 'Crescentic'; both dorsal and ventral sides have single-flake surfaces. (BBP-Sf, 41.)

27. Point, sub-type Gx; crystal. Right edge only slightly trimmed and more or less straight; left edge steeply blunted in a way that two 'arms' are produced, the upper being shorter and more oblique and ending in a point. (BBP-2, 28.)

28. Point, sub-type Gx; basalt. Only the upper 'arm' on the right blunted. (BBP-Sf, 42.)

29. Point, sub-type Gxi; chalcedony. Left edge steeply blunted, forming a curve which ends in a beak-like point; right edge untrimmed, but bears use-marks; base wide and retouched; very likely a composite tool serving both as a point and a blade. (BBP-Sf, 43.)

30. Point, sub-type Gxi; chalcedony. Left edge steeply blunted and ending in a point; right edge bearing use-marks; base wide and steeply blunted; probably blade-*cum*-point. (BBP-Sf, 44.)

31. Point, sub-type Gxi; chert. Right edge steeply blunted and ending in a beak-like point; left edge bears use-marks; base wide and retouched; probably blade-*cum*-point. (BBP-Sf, 45.)

(viii) *Type H: borers* (fig. 11, *1-5*; pl. IX B, *1-5*)

On the basis of the shape of the working end, the borers are divisible into the following sub-types.

Sub-types Hi and *Hii* both have two shoulders whereby a roughly medial working point is produced. The distinction between them, however, is that while in the former the point is small (fig. 11, *1* and *2*; pl. IX B, *1* and *2*), in the latter it is long and well-pronounced (fig. 11, *3*; pl. IX B, *3*).

In contrast to the former group, *sub-type Hiii* has a single shoulder with the result that the working point is not medial but on one side (fig. 11, *4* and *5*; pl. IX B, *4* and *5*).

The following specimens are illustrated (fig. 11; pl. IX B).

1. Borer, sub-type Hi; quartz. Two shoulders; small, medial wroking point. (Cluster C, 47.)

2. Borer, sub-type Hi; crystal. Two shoulders; small, medial working point. (BBP-Sf, 52.)

3. Borer, sub-type Hii; crystal. Two shoulders; well-pronounced, medial working point. (Cluster C, 1.)

4. Borer, sub-type Hiii; crystal. Single shoulder; well-pronounced working point on the left; both right and left edges of the pointed portion retouched, the latter inversely. (BBP-Sf, 49.)

5. Borer, sub-type Hiii; crystal. Single shoulder; well-pronounced working point on the right. (BBP-Sf, 48.)

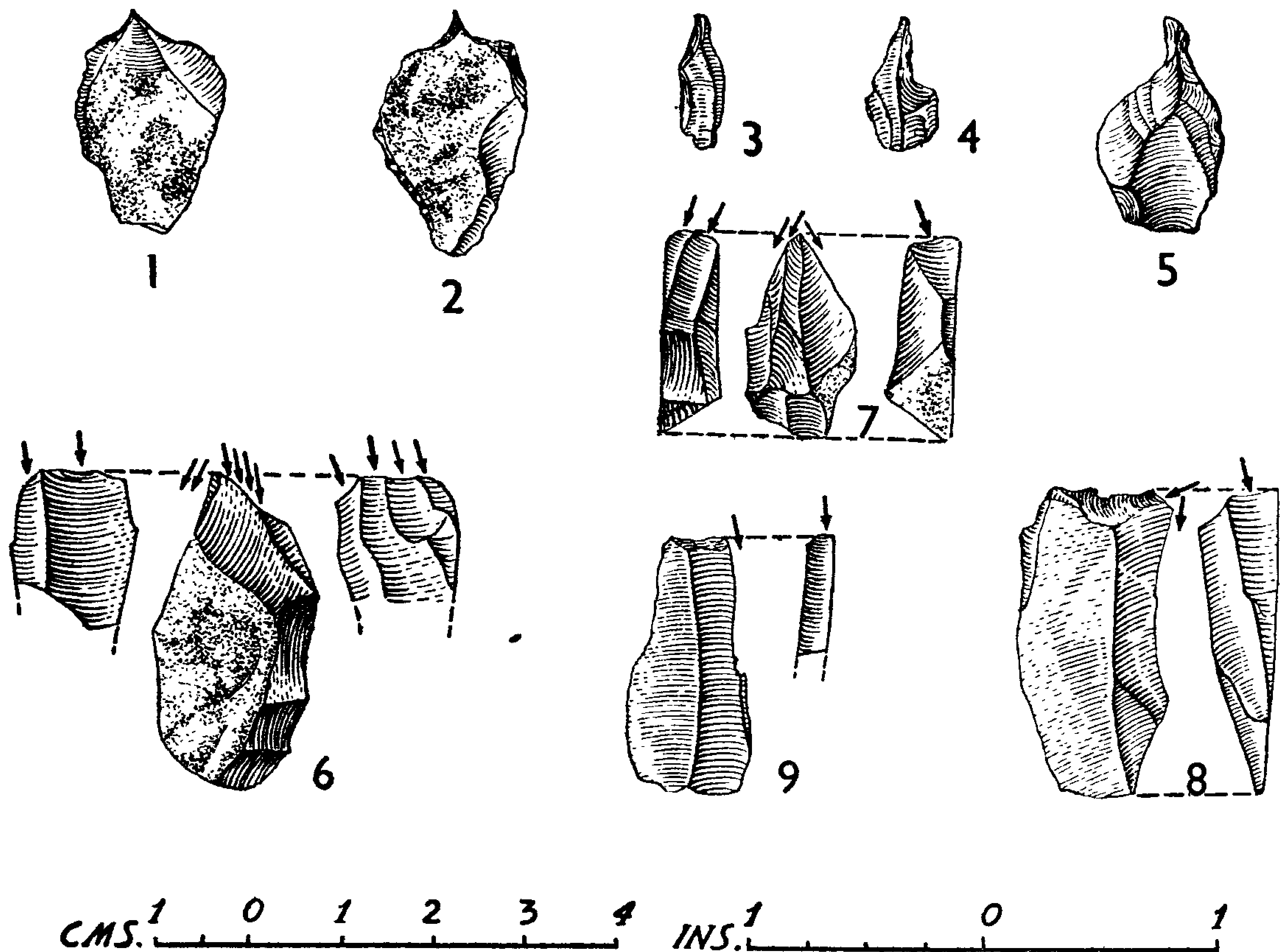


FIG. 11. *1-5, borers; 6-9, burins*

(ix) *Type I: burins* (fig. 11, *6-9*; pl. IX B, *6-9*)

On the basis of the disposition of the working end and the technique adopted in its preparation, the burins in the present collection are divisible into the following sub-types.[1]

In *sub-type Ii* (fig. 11, *6* and *7*; pl. IX B, *6* and *7*) the working end is produced by the removal of one or more vertical or oblique spalls against another set of similar spalls.

In *sub-type Iii* (fig. 11, *8*; pl. IX B, *8*) the working end is produced by the removal of a transverse spall against a vertical one.

Sub-type Iiii (fig. 11, *9*; pl. IX B, *9*) differs from sub-type Iii inasmuch as the transverse edge is formed not by the removal of a spall but by steep retouch.

The following specimens are illustrated (fig. 11; pl. IX B).

6. Burin, sub-type Ii; quartz. Two oblique spalls opposed to four oblique spalls. (BBP-1, 103.)

7. Burin, sub-type Ii; crystal. Two oblique spalls opposed to one oblique spall. (BBP-Sf, 54.)

[1] H. V. V. Noone in *Jour. Roy. Anthrop. Inst.*, LXIV (1934), pp. 81-92, has made a good classification of burins. The sub-types mentioned here are covered by those of Noone.

8. Burin, sub-type Iii; chert. A transverse spall opposed to a vertical spall on the right. (BBP-1, 101.)

9. Burin, sub-type Iiii; chert. Steeply retouched transverse edge opposed to a vertical spall on the right. (BBP-Sf, 53.)

(x) *Type J: scrapers* (fig. 12; pl. X)

Of scrapers, the following sub-types are available.

Sub-type Ji (fig. 12, *1-3*; pl. X, *1-3*) is a round or discoid scraper made either on flake or core.

Sub-type Jii (fig. 12, *4*; pl. X, *4*) slightly differs from the above as its scraping edge does not cover the entire periphery. Thus, a distinct 'butt' is left over.

Sub-type Jiii (fig. 12, *5-8*; pl. X, *5-8*) is a side-scraper, in which one of the longer sides is retouched to form a straight scraping edge.

Sub-type Jiv (fig. 12, *9-12*; pl. X, *9-12*) is an end-scraper in which the working edge is obtained by retouching one of the shorter, i.e. transverse, sides of a flake or core.

In *sub-types Jv and Jvi* the scraping edge is concave. In the former it is on one of the sides (fig. 12, *13-15*; pl. X, *13-15*), while in the latter it is at the end of the flake or core (fig. 12, *16*; pl. X, *16*).

The following specimens, representing various sub-types of scrapers, are illustrated (fig. 12; pl. X).

1. Scraper, sub-type Ji; chert. Round scraping edge. (BBP-Sf, 57.)

2. Scraper, sub-type Ji; milky quartz. Round scraping edge; made on core. (BBP-2, 39.)

3. Scraper, sub-type Ji; chalcedony. Round scraping edge. (BBP-Sf, 58.)

4. Scraper, sub-type Jii; crystal. Scraping edge does not cover the entire periphery; thus distinct butt left over; made on pebble-core. (BBP-Sf, 59.)

5. Scraper, sub-type Jiii; chert. Scraping edge on left side; made on core. (BBP-Sf, 60.)

6. Scraper, sub-type Jiii; fossil-wood. Inversely retouched scraping edge on left side. (BBP-1, 108.)

7. Scraper, sub-type Jiii; crystal. Scraping edge on left side. (BBP-2, 40.)

8. Scraper, sub-type Jiii; chalcedony. Scraping edge on left side. (BBP-Sf, 61.)

9. Scraper, sub-type Jiv; chert. Transverse edge retouched to form an end-scraper. (BBP-1, 109.)

10. Scraper, sub-type Jiv; quartz. Transverse edge retouched to form an end-scraper. (Cluster C, 2.)

11. Scraper, sub-type Jiv; chert. Transverse edge retouched to form an end-scraper. (BBP-1, 110.)

12. Scraper, sub-type Jiv; chert. Fluted core further retouched to form an end-scraper. (BBP-Sf, 62.)

13. Scraper, sub-type Jv; chert. Concave scraping edge on left side. (BBP-Sf, 63.)

14. Scraper, sub-type Jv; chert. Concave scraping edge on left side. (BBP-Sf, 64.)

15. Scraper, sub-type Jv; crystal. Made on core; inversely retouched, concave scraping edge on left side. (BBP-Sf, 65.)

16. Scraper, sub-type Jvi; chert. Transverse edge steeply retouched to form a concave scraper. (BBP-2, 41.)

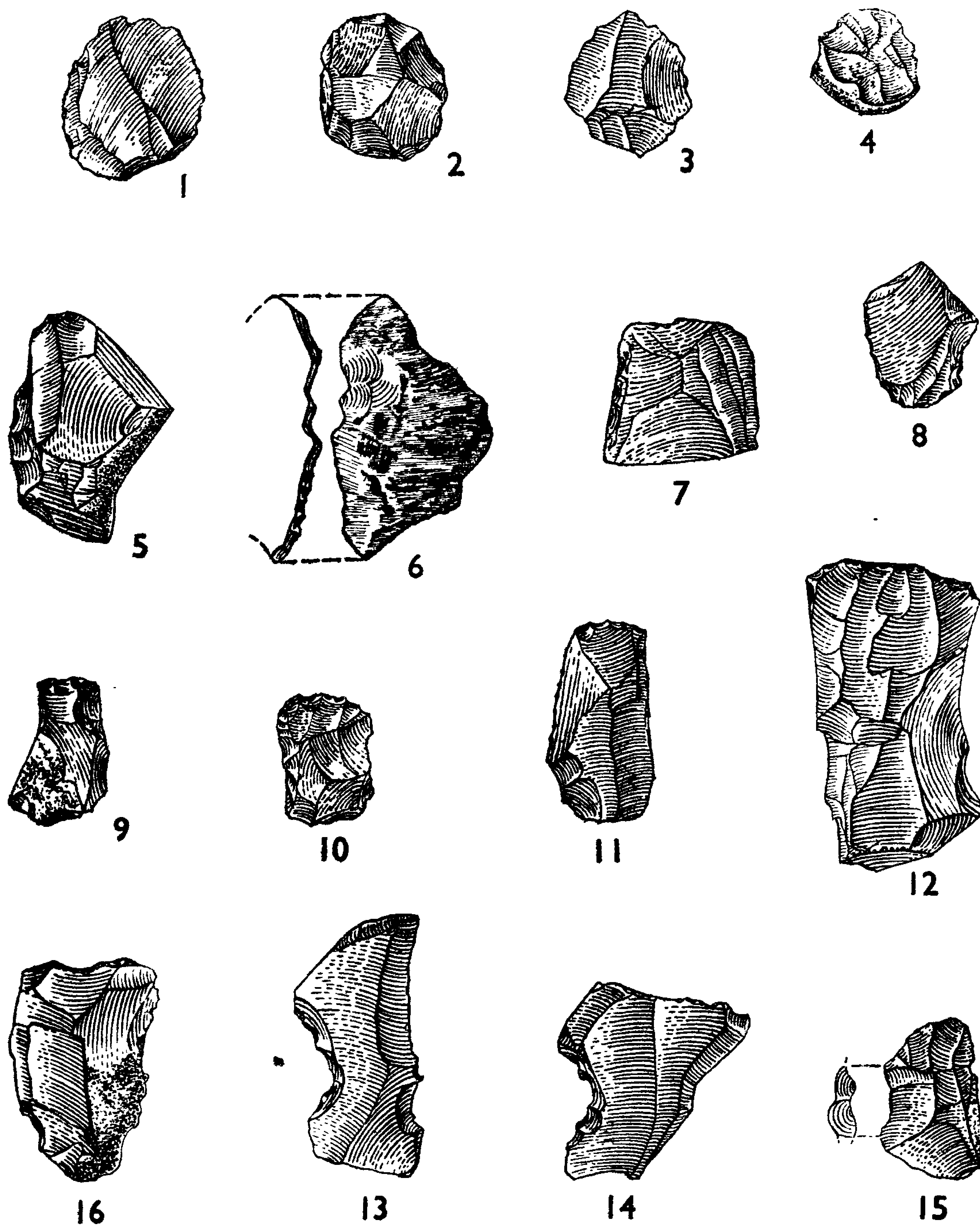


FIG. 12. *Scrapers*

TABLE 2

TYPOLOGICAL ANALYSIS OF THE BIRBHANPUR MICROLITHIC INDUSTRY

Locus / *Types*	ANALYSIS OF ARTEFACTS				ANALYSIS OF TOOLS								
	Cores *A*	*Flakes* *B*	*Tools* *C to J*	*Total of A to J*	*Blades* *C*	*Lunates* *D*	*Trape-zes* *E*	*Tri-angles* *F*	*Points* *G*	*Borers* *H*	*Burins* *I*	*Scrapers* *J*	*Total of C to J*
Trench BBP-1	166 *6·2*	2356 *89·0*	125 *4·7*	2647	38 *30·4*	17 *13·6*	...	...	37 *29·6*	8 *6·4*	7 *5·6*	18 *14·4*	125
Trench BBP-2	41 *6·8*	510 *85·7*	44 *7.3*	595	19 *43·1*	7 *15·9*	...	...	7 *15·9*	3 *6·9*	4 *9·0*	4 *9·0*	44
Cluster A (Surface) ...	11 *7·1*	134 *85·8*	9 *5·8*	154	4 *44·4*	1 *11·1*	...	...	3 *33·3*	...	...	1 *11·1*	9
Cluster B (Surface) ...	50 *8·9*	478 *85·8*	29 *5·2*	557	12 41·3	5 *17·2*	...	...	4 *13·7*	4 *13·7*	...	4 *13·7*	29
Cluster C (Surface) ...	23 *10·3*	184 *82·5*	16 *7·1*	223	5 *31·2*	4 *25·0*	...	...	4 *25·0*	1 *6·2*	...	2 *12·5*	16
Cluster D (Surface) ...	11 *9·8*	96 *85·7*	5 *4·4*	112	1 *20·0*	...	...	...	1 *20·0*	...	...	3 *60·0*	5
Cluster E (Surface) ...	69 *6·0*	1016 *89·2*	54 *4·7*	1139	27 *50·3*	8 *14·8*	...	...	4 *7·4*	3 *5·5*	1 *1·8*	11 *20·3*	54
Total	371 *6·8*	4774 *87·9*	282 *5·1*	5427	106 *37·5*	42 *14·8*	...	...	60 *21·2*	19 *6·6*	12 *4.2*	43 *15·3*	282

Note: *No analysis is given here of other surface-collections as they are stray and consequently have little statistical value. It must, however, be mentioned that they include one specimen of trapeze (type E) and one doubtful example of triangle (type F). The figures in italics represent percentage.*

6. OTHER MICROLITHIC SITES IN THE NEIGHBOURHOOD AND SCOPE FOR FURTHER WORK

An exploration of the area around Birbhanpur brought to light three other microlithic sites, viz. Dejuri, Malandighi and Gopalpur (fig. 1).[1] Of these, the last-named site was discovered by Shri Ajit Mukherji who informed the author about it; but as the latter did not visit it, no details about the stratigraphical position and typological character of the microlithic industry can be given here. Brief observations about the other two sites are as follows.

Dejuri is situated at a distance of about 8 miles south-south-west of Durgapur, on the Durgapur-Bankura road. It is located on the penultimate terrace on the right bank of the Damodar river, which is just the counterpart of the microlith-bearing terrace (T_{n-1}) near Birbhanpur on the left bank. Thus, the stratigraphical position of the microlithic industry at Dejuri was found to be identical with that of Birbhanpur, i.e. that the specimens underlay the same kind of sandy earth as was encountered at Birbhanpur and were thus anterior to it. Within an hour that the author was at the site, he collected about a couple of hundred specimens, a general examination of which showed that the microlithic industry of Dejuri was similar to that of Birbhanpur, in respect of both typology and the choice of material. It may also be stated that no triangle or trapeze was found at Dejuri, but the point should not be unduly emphasized in view of the incompleteness of the collection.

The other site, Malandighi, is located at a distance of about 6 miles from the point where a branch-road takes off from the Grand Trunk Road towards Jaydeb Kenduli on the north (fig. 1). The microliths were found a few furlongs to the north of the village on the fringe of a young jungle of *sāl*-trees. They lay in the same geological context as those at Birbhanpur and Dejuri, and typologically too they belonged to the same industry.

Further exploration in the neighbouring areas is likely to yield some useful results. First, many more microlithic sites, of comparable antiquity, are likely to be discovered. Secondly, in the higher regions on the north and west, where the level goes up by about 300 ft. (cf. fig. 1), terraces of the Damodar river which may be older than the penultimate terrace, T_{n-1}, observed near Birbhanpur, are likely to be encountered. Thirdly, it may not be too much to expect earlier lithic industries in these terraces, which might take the story back even to the palaeolithic times. Some encouragement in the last-named direction is given by the fact that the author did pick up a palaeolithic flake-tool from a bed of lateritic gravel between Malandighi and Jaydeb Kenduli. This stray specimen does not mean much by itself, but is, at the same time, a pointer towards the potentiality of the area.

7. PROBABLE ANTIQUITY OF THE MICROLITHIC INDUSTRY

Let it be stated at the very outset that there is no direct evidence, such as provided by the radio-carbon test, for dating the microlithic industry of Birbhanpur in precise terms. One has thus to fall back upon indirect or circumstantial evidence, from which, however, only broad inferences can be drawn regarding the antiquity of the industry. Such evidence is deducible from (i) a comparison of the typological and other features of this industry with those of other microlithic industries of the country and (ii) the geological context

[1]The already-known site of Nadiha (above, p. 16 n.) has not been taken into account here, as, according to the available evidence, the microliths obtained from here belong to a later series.

of the industry at Birbhanpur itself. May it, however, be added that while the geological evidence, being objective, may be dependable to a certain degree, the typological evidence has always room for subjectivity and other unknown elements,—for what guarantee is there against the existence of backwaters side by side with an ever-flowing stream? Thus, any date suggested for the microlithic industry of Birbhanpur in the present state of our knowledge can at best be only tentative.

To take up the typological evidence. As mentioned above (pp. 15-16), the surface-collection from Birbhanpur included a large number of blades, lunates, points, borers, burins, and scrapers, but only one example of trapeze and a doubtful example of triangle. In the excavated trenches, however, no triangle or trapeze was encountered, although all the other types were found. While one should not set aside the single specimen of trapeze and the doubtful example of triangle, even though found on the surface, one cannot, at the same time, say with any degree of certainty that these two types did form regular constituents of the Birbhanpur microlithic industry. Thus, pending a further investigation of the issue, all that may be said for the present is that the industry seems to be *essentially* non-geometric.[1]

Another noteworthy feature of this industry is the absence of any associated pottery. Now, while the mere absence of pottery need not necessarily mean that the industry was pre-pottery, an obvious question does arise: if the art of making pottery was known to the authors of the microliths, why should they have meticulously avoided its use? In view of the fact that the microlithic industry occurs in a geological context which is indicative of a high antiquity, it seems likely that the absence of pottery is due to its non-advent, at least in the region, rather than to mere chance.

Still another noteworthy point about the industry is the absence of the 'crested ridge'—a feature so typical of the microlithic industries of the chalcolithic period.[2]

To sum up, the microlithic industry of Birbhanpur has the following three important, though negative, features:—

(i) absence (or rarity) of typical geometric forms like the trapeze and triangle;
(ii) absence of pottery; and
(iii) absence of the 'crested ridge'.

Let it now be examined if and how far these features help us in ascertaining the age of the industry. Such an examination must be circumscribed by the fact that other comparable industries of the country are themselves not dated in absolute terms and can, therefore, lead to only a broad and relative dating.

To proceed backwards from the more recent times. It is known that in the first and second millennia B.C. microliths occur in a chalcolithic context, for example at Brahmagiri,[3] Maski,[4] Maheshvar,[5] Nasik,[6] etc., not to speak of the Harappan sites,[7] where they occur,

[1] For a more detailed discussion, see above, pp. 15-16.

[2] B. Subbarao, 'Chalcolithic blade industry of Maheshvar (central India) and a note on the history of the technique', *Bulletin Deccan College Res. Inst.*, XVII (1955-56), pp. 126 ff.

[3] R. E. M. Wheeler, 'Brahmagiri and Chandravalli 1947: megalithic and other cultures in Mysore State', *Ancient India*, no. 4 (1947-48), pp. 180 ff.

[4] B. K. Thapar, 'Maski 1954: a chalcolithic site of the southern Deccan', *Ancient India*, no. 13 (1957), pp. 4 ff.

[5] H. D. Sankalia, B. Subbarao and S. B. Deo, 'The archaeological sequence in central India', *Southwestern Jour. Anthrop.*, IX, no. 4 (1953), pp. 343 ff.

[6] H. D. Sankalia and S. B. Deo, *Report on the excavations at Nasik and Jorwe 1950-51* (Poona, 1955).

[7] J. Marshall and others, *Mohenjo-daro and the Indus Civilization* (London, 1931), III, pl. CXXXI; M. S. Vats, *Excavations at Harappā* (Delhi, 1940), II, pl. CXVIII.

in the form of ribbon-flakes, even a millennium earlier. At all such places, they are associated with metal and pottery; sometimes they include typical geometric shapes like the trapeze and triangle; and the 'crested ridge' technique was employed in their preparation. As all these features are altogether absent in the Birbhanpur microlithic industry, it seems highly probable that this industry is anterior to that occurring in the chalcolithic context, although, in the absence of a direct stratigraphical evidence, it must not be taken as proved. In this connexion, however, one may recall the evidence from Rangpur in Gujarat, where microliths occur below the Harappan levels:[1] they include typical geometric forms and are not associated with pottery. The latter point, however, may not be overstressed in view of the limited extent of the excavated area and of the fact that the material occurred in a gravel lens. Nevertheless, we do have here a microlithic industry, which is definitely pre-Harappan and may, therefore, be placed at least in the third millennium B.C., if not earlier. Now, if it is presumed that in the microlithic industries the typical geometric element made its appearance at a late stage, it would follow that the non-geometric or, at any rate, the essentially non-geometric and pre-pottery microlithic industry of Birbhanpur may not have been later than the fourth millennium B.C., although here again direct stratigraphical evidence alone would settle the issue satisfactorily.

Besides Birbhanpur, quite a few sites or areas have yielded microliths which, for the sake of convenience, may be broadly classed as 'pre-chalcolithic': to name some, Langhnaj (Period I)[2] and the Mahi valley[3] in Gujarat; Sanganakallu (Phase I)[4] and Jalahalli[5] in Mysore; Khandivli[6] near Bombay; the *Teris*[7] in Madras State; Giddalur and other sites near Nandikanama Pass[8] in Andhra Pradesh; the Singrauli basin[9] in Uttar Pradesh; the area around Chakradharpur[10] in Bihar, etc. Within themselves, however, the 'pre-chalcolithic' microlithic industries differ considerably—some are associated with pottery while others are not, or some have the typical geometric element while others are without it. Thus, they do not fall within one single culture-complex and may perhaps represent various stages in the evolution of the microlithic cultures in general. However, although a comprehensive stratigraphy is not yet available to establish firmly the story of this evolution, a tentative piecing together on the following lines may not be perhaps far off the point.

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[1] Information from Shri S. R. Rao. Cf. *Indian Archaeology—a Review 1953-54* (New Delhi, 1954), p. 7.

[2] H. D. Sankalia, 'The microlithic industry of Langhnaj, Gujarat', *Jour. Gujarat Res. Soc.*, XVIII, no. 4 (Oct. 1956), pp. 275-84; and other earlier papers mentioned therein.

[3] B. Subbarao, 'Archaeological explorations in the Mahi valley', *Jour. M. S. University of Baroda*, I (1952), pp. 33 ff.

[4] B. Subbarao, *Stone Age Cultures of Bellary*, Deccan College Dissertation Series, no. 7 (Poona, 1948).

[5] M. Seshadri, *The Stone-using Cultures of Prehistoric and Protohistoric Mysore* (London, 1956); K. R. U. Todd, 'A microlithic industry in eastern Mysore', *Man*, XLVIII (1948), no. 27, pp. 28-30.

[6] K. R. U. Todd, 'Palaeolithic industries of Bombay', *Jour. Royal Anthrop. Inst.*, LXIX, pt. II (1939), pp. 257 ff.

[7] F. E. Zeuner and Bridget Allchin, 'The microlithic sites of Tinnevelly District, Madras State', *Ancient India*, no. 12 (1956), pp. 4 ff.; and other earlier articles mentioned therein.

[8] K. V. Soundara Rajan, 'Stone Age industries near Giddalur, District Kurnool', *Ancient India*, no. 8 (1952), pp. 64 ff.; M. C. Burkitt and L. A. Cammiade, 'Fresh light on the Stone Age of south-east India', *Antiquity*, IV (1930), pp. 327 ff.

[9] V. D. Krishnaswami and K. V. Soundara Rajan, 'The lithic tool-industries of the Singrauli basin', *Ancient India*, no. 7 (1951), pp. 40 ff.

[10] Information from Dr. B. Subbarao. Since the above was written, a paper has been published on the same subject by D. Sen and Uma Chaturvedi: 'Microlithic industry of Singhbhum', *Man in India*, 37, no. 4 (1957), pp. 294 ff.

At the sub-stratum there was a 'blade-and-burin' industry, which, in course of time, evolved into a microlithic industry consisting of blades, scrapers, borers, burins and lunates, but not triangles or trapezes. These two last-named types, essentially geometric, came into being somewhat later. Exactly at what stage the use of pottery commenced cannot be said with certainty, but the available evidence would indicate that it may have been after the appearance of the typically geometric element. Such, in short, seems to have been the story of the 'pre-chalcolithic' microlithic industries of India, with the proviso, however, that the different parts of the country may not necessarily have witnessed all the aforesaid stages and that in certain areas an earlier stage may have lingered on while other areas took several forward steps in the meantime.

Against such a background, the Birbhanpur microlithic industry would appear to claim for itself a very early position—in fact at the very emergence of the microlithic element from the preceding 'blade-and-burin' industry. And at such a position the Birbhanpur industry does not stand all by itself: the microlithic industries of the Singrauli basin, Giddalur II and other sites near Nandikanama Pass and the *Teris* join hands with it, and with them may also go the earliest microlithic industry of Khandivli and the one near Chakradharpur. The microlithic industry of the Singrauli basin has been noted as lying about 4 ft. below the Upper Alluvium; it does not contain the typical geometric forms, viz. the triangle and trapeze, nor is there any associated pottery. It has been ascribed to 'probably an early Mesolithic period'.[1] The Giddalur II industry, also bereft of the geometric element and pottery, has been regarded by the concerned writer as 'an Epi-palaeolithic microlithic industry'.[2] At other Nandikanama Pass sites a lithic industry consisting of blunted-back knife-blades, core-scrapers, burins and crescents, but without the typical geometric element (and evidently also without any pottery), was found on the surface of a red clay, which itself was overlain by a red sandy soil.[3] The writers have not categorically assigned any date to this industry, but their general remarks imply that the industry may be early Mesolithic, if not somewhat older. At Khandivli an industry which Todd calls 'a more developed blade and burin' industry, occurs in the Upper Clay, and this was followed by 'a microlithic industry' on or slightly below the surface.[4] Gordon is rightly inclined to class even the former industry as 'microlithic',[5] but it is not very clear when the lunate made its appearance. The microlithic industry from the Sanjai valley near Chakradharpur, Dr. Subbarao says, has the lunate but not the triangle and trapeze and is not associated with any kind of pottery. The present writer is not aware of the geological context of the Chakradharpur industry, but on typological grounds it would seem to be simliar to that of Birbhanpur.

[1] Krishnaswami and Soundara Rajan, *op. cit.*, pp. 59-60.

[2] Soundara Rajan, *op. cit.*, p. 89.

[3] Cammiade and Burkitt, *op. cit.*, p. 338. I have deliberately avoided using their term 'Series 3' for this industry, as there does not seem to be a full agreement between the detailed description of the tools given on p. 338 and the definition of Series 3 given on p. 328, wherein the lunate is not mentioned; maybe in the general definition such a specific mention was not considered necessary by the writers, or, as D. H. Gordon has postulated [*Ancient India*, no. 6 (1950), p. 65], their Series 3 is further divisible into two, 'Lower' and 'Upper', in which case the one containing the lunate may belong to the latter category. Whatever the case may be, it is clear that the lunate-element is older than their Series 4, which contains the typical geometric forms, and that it (i.e. the lunate-element) was associated with Series 3, or at least a phase thereof, which underlay the red sandy soil.

[4] Todd, *op. cit.* (1939), p. 267.

[5] D. H. Gordon, 'The stone industries of the Holocene in India and Pakistan', *Ancient India*, no. 6 (1950), p. 65.

It would be seen from the foregoing that the respective writers have regarded the Mirzapur, Giddalur, Nandikanama Pass and other allied microlithic industries as fairly old but, beyond saying in a general way that the industries may be 'early Mesolithic' or 'Epi-palaeolithic microlithic', they have not suggested any absolute dates, which, it is admitted, was not possible without further work on the geological context of the concerned industries. In the case of the *Teris*, however, Zeuner has made a very commendable attempt in this direction by trying to correlate the microlithic industry with the ancient sea-levels. The main[1] *Teri* industry, viz. the one represented by the finds from Sawyerpuram, Kuttampuli, and other allied sites, has the lunate but very little, if any, of the real geometric element; nor is there any associated pottery. Zeuner has dated this industry to *circa* 4000 B.C., with the proviso that further geological research may push it back into the Pleistocene.[2]

A comparison between the *Teri* and Birbhanpur microlithic industries shows that the former contains, in addition to most of the types of the latter, bifacial points, a few examples of the triangle, and one specimen of the microburin. The bifacial points are similar to those from Ceylon and may perhaps indicate some kind of contact with that country, which is perfectly understandable in view of the proximity of the two areas. The microburin and triangle, however, suggest a kind of 'advance' over the Birbhanpur industry. This point, at the same time, need not be stressed much because of the limited number of the specimens even at the *Teri* sites. There is no associated pottery at either the *Teri* sites or Birbhanpur. All this would imply that purely from the typological point of view the Birbhanpur industry is as old as, if not somewhat older than, that of the *Teris*. Such a position would entitle it to a minimum date of 4000 B.C. with a proviso, as put forth by Zeuner in the case of the *Teri* industry, that it may be pushed back even much earlier.

Let us now see what light, if any, the geological context of the industry at Birbhanpur itself can throw on its antiquity. As has been stated above (p. 9), the microliths were found in the penultimate terrace, T_{n-1}, of the Damodar. Now, as the entire terrace-sequence of the area and its probable correlation with the climatic (Pluvial and Interpluvial, or Glacial and Interglacial) phases of the Pleistocene have not been worked out, it is extremely difficult to say anything definite about the position of this terrace in the Pleistocene sequence. However, an obvious question arises: do both the terraces, T_n and T_{n-1}, belong to the Holocene? While the youngest terrace, T_n, with an average height of only about 25 ft. above the river-level, evidently belongs to the Holocene, is the penultimate terrace, T_{n-1}, also, which has an average height of about 50 ft. above the river-level and rises even to a height of about 75 ft. in the upper regions, post-Pleistocene? While no positive answer can be offered to such a query without further work in the area, it would be worth while here to consider, in brief, the results of the soil-analysis carried out by Dr. B. B. Lal, Archaeological Chemist in India (below, pp. 39 ff.). His analysis has shown that the deposits immediately preceding the microlithic deposit, i.e. layers 3 and 5 of Trenches BBP-1 and BBP-2 respectively, were formed under hot and humid conditions, which he is inclined to assign to the last pluvial phase of the Pleistocene (p. 47), and that with the setting in of milder and drier climatic conditions, the microlithic man appeared on the scene. The microlithic deposit was finally sealed by a 2½- to 3-ft. thick deposit of sandy earth, which, as the analysis has shown, was laid down under semi-arid conditions and has undergone weathering in the course of time. On this

[1]The industry from Megnanapuram may, however, represent a still earlier stage, for it is reported to lack the blade and geometric forms and is perhaps associable with the 50-ft. sea-level. Zeuner and Allchin, *op. cit.*, pp. 8-9.

[2]Zeuner and Allchin, *op. cit.*, pp. 7-8.

basis, the microlithic industry may be placed vaguely somewhere early in the Holocene. But to say anything more than that in the present state of knowledge would be rather unwarranted.

8. ENVIRONMENTAL CONDITIONS AT BIRBHANPUR DURING THE TIMES[1]

A. Introduction

With a view to studying the climatic conditions prevailing at the time of the formation or deposition of the layers encountered in the excavation, thirty soil-samples were collected, seventeen from Trench BBP-1 and thirteen from Trench BBP-2.

A description of the layers in the two trenches is given below.

Trench BBP-1: 1A, loose sandy earth; 1B, sandy earth, dark; 1C, sandy earth, light-brown; 2, earth with coarse granules (implementiferous); 3, lateritic gravel with stone fragments; 4, mottled silty sand; and 5, decayed sandstone, whitish.

Trench BBP-2: 1, sandy earth, dark; 2, sandy earth, light-brown; 3, granular sand with lateritic pellets; 4, reddish silty sand with lateritic pellets; and 5, mottled silty sand with lateritic pellets.

The samples were microscopically examined, chemically analysed and subjected to mechanical analysis for the determination of the mode of origin of the layers and the relationship between the parent rock and the overlying sediments. Attempts were also made to determine the physical, optical and detrital characters of minerals, such as colour, form and inclusions, which are of great value in correlation and provenance studies. In such a geochronological investigation it is of paramount importance to determine whether a particular deposit represents a weathering *in situ* (residual deposit) or it has been laid down from some outside source. On theoretical grounds any mineral present in the parent rock is to be anticipated in the sediments derived therefrom, but it is the very abundant or the very stable and resistant minerals of the parent rock that are likely to survive and appear in the sediments. Further, a weathering *in situ* is accompanied by a distinct corrosion of heavy minerals as compared with the heavy minerals present in the fresh rock. Heavy minerals, therefore, are particularly useful for this type of investigation, viz. correlation and study of origin of sediments or soils, and for this reason a detailed heavy-mineral analysis was also undertaken; the results of the analysis will be published in due course.

B. Technique of examination

The following methods were employed in the study of the soil-samples:

(i) *mechanical analysis* of fine particles by the hydrometer-method and of coarse fractions by the sieve-method;

(ii) *microscopic examination* of sand-grains for the determination of their optical, physical and detrital characters, including surface-features and shape, and of the composition of sands; and

[1] Contributed by Dr. B. B. Lal, Archaeological Chemist in India, Dehra Dun.

(iii) *chemical analysis*, including the determination of calcium carbonate, phosphate, alkalis and humus.

(i) *Mechanical analysis*

The samples were subjected to mechanical analysis by the hydrometer-method.

Fifty grams of air-dry soil, obtained after sieving through 30-mesh (0·50 mm.) sieve, were mechanically agitated and dispersed in distilled water, so that the particles became uniformly distributed and small aggregates separated into individual grains as far as possible without the use of any dispersing agent. Lumps were broken up by hand: this was generally easy as the samples were mostly friable and cohesionless. Those samples which, on drying, became hard and showed large agglomerations of particles were also broken up by hand before sieving; coarse particles were considered to be rock-fragments if they did not soften on immersion in water.

The soil so dispersed in distilled water was transferred to a 1000-cc. measuring cylinder previously calibrated and made up to the 1000-cc. mark. The suspension in the cylinder was shaken gently by turning the latter up and down several times; thereafter the cylinder was placed on a heavy table to ensure an undisturbed sedimentation of the particles. The variation in the specific gravity of the suspension was noted by the use of long- and short-stem hydrometers which had been previously used for calibration of the graduated cylinder. The first reading was taken as soon as possible after resting the graduated cylinder on the table, and subsequent readings were taken at frequent intervals. The percentage of particles of a particular size and smaller ones was then calculated according to the usual procedure. When the sedimentation readings had been taken, the contents of the graduated cylinder were transferred to a set of sieves for the gradation of the coarse particles into different sizes.

The results of the sieve-analysis, combined with those of sedimentation, are recorded in Tables 3 and 4. They show that in Trench BBP-1, starting from the modern land-surface downwards, layers 1B, 1C and 2 are composed of medium to fine sand with varying proportions of silt which is present in appreciable quantities in the middle and lower parts of layer 1C. This silty sand contains 34 to 41 per cent silt and 1 to 4 per cent clay, the proportion of the latter rising to 7 to 8 per cent towards the base of layer 1C. The implementiferous layer, 2 (represented by samples 8 and 9 in its upper part and 10 and 11 in its lower part), consists of sand, silt and clay, the last-named item being present to the extent of 12 to 13 per cent in the upper part.

Layer 3 (represented by samples 12, 13 and 14) is composed of silty sand apart from lateritic gravel and stone fragments. The stones do not appear to be erratics in the section but seem to represent fragments of hard pan deposited *in situ* as a result of the movement of ground-water.

Layers 4 and 5 (represented by samples 15, 16 and 17) below the hard pan show a much higher proportion of sand and lesser amounts of silt and clay: the lower part of layer 5 (sample 17) contains 92 per cent medium to fine sand and only 8 per cent silt; layer 4 (sample 15) contains 80 per cent sand and 20 per cent silt, while the lower part of layer 3 (sample 14) contains only 61 per cent sand but 39 per cent silt. These samples, therefore, represent the bed-rock in varying stages of weathering and, as the microscopic examination has revealed, the quartz-grains show little evidence of transportation. It can safely be inferred, therefore, that these layers represent a weathering *in situ* derived from the bed-rock, a coarse-grained sandstone. Layer 5 has, therefore, appropriately

Table 3

MECHANICAL ANALYSIS OF SOIL-SAMPLES FROM TRENCH BBP-1

Layer ...	*1B*		*1C*					2 (*implementiferous*)				*3*			*4*	*5*	
Serial no. of sample ...	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*
Depth below surface ...	5″	6½″	10″	11″	1′4½″	1′10″	1′10½″	2′1″	2′2½″	2′5″	2′7½″	2′9″	4′2″	5′9½″	6′11″	7′8½″	10′1″
Percentage composition:																	
Medium sand (·6-·2 mm.)	48·3	36·1	27·3	36·6	33·0	33·6	32·2	32·0	32·4	25·3	27·2	20·0	28·4	25·3	22·7	31·9	45·0
Fine sand (·2-·06 mm.)	44·7	59·9	31·7	28·4	24·0	28·4	30·8	24·0	31·6	55·7	49·8	34·0	41·6	35·7	57·3	60·1	47·0
Coarse silt (·06-·02 mm.)	7·0	4·0	22·0	16·0	12·0	7·0	6·0	11·0	8·0	17·0	11·0	13·0	10·0	10·0	4·0	6·0	4·0
Medium silt (·02-·006 mm.)	...	...	9·0	16·0	26·0	9·0	9·0	12·0	9·0	2·0	9·0	13·0	18·0	29·0	8·0	2·0	4·0
Fine silt (·006-·002 mm.)	...	...	6·0	2·0	3·0	22·0	14·0	9·0	6·0	...	2·0	6·0	1·0	...	7·0	...	...
Clay (<·002 mm.)	...	...	4·0	1·0	2·0	...	8·0	12·0	13·0	...	1·0	14·0	1·0	...	1·0	...	...

TABLE 4

MECHANICAL ANALYSIS OF SOIL-SAMPLES FROM TRENCH BBP-2

Layer	*1*	*2*			*3*	*4* (*implementiferous*)						*5*	
Serial no. of sample	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
Depth below surface	*4½"*	*10"*	*1'7"*	*2'4½"*	*2'9½"*	*3'4"*	*4'*	*4'1"*	*4'2"*	*4'2½"*	*4'4"*	*4'11"*	*5'3"*
Percentage composition:													
Medium sand (·6-·2 mm.) ...	44·5	41·5	37·4	34·3	30·4	22·5	26·2	27·0	28·8	26·3	25·2	24·3	23·6
Fine sand (·2-·06 mm.) ...	38·5	49·5	38·6	42·7	55·6	54·5	40·8	35·0	27·2	36·7	28·8	9·7	43·4
Coarse silt (·06-·02 mm.) ...	17·0	3·0	14·0	19·0	12·0	19·0	5·0	11·0	14·0	17·0	24·0	21·0	12·0
Medium silt (·02-·006 mm.) ...	...	2·0	5·0	2·0	1·0	4·0	15·0	27·0	24·0	18·0	20·0	43·0	5·0
Fine silt (·006-·002 mm.) ...	...	2·0	3·0	1·0	1·0	...	3·0	...	6·0	1·0	1·0	1·0	7·0
Clay (<·002 mm.) ...	...	2·0	2·0	1·0	...	...	10·0	...	...	1·0	1·0	1·0	9·0

been described as 'decayed sandstone, whitish'. The presence of coarse-grained sandstone has been confirmed by a survey of the neighbouring railway-cutting which presents a cliff more than 60 to 70 ft. high with exposures of weathered rock showing whitish and reddish horizons. The lower portion of the cliff was examined and samples of semi-weathered rock were collected from different levels. The rock has been petrographically examined and found to be a coarse-grained sandstone.

In Trench BBP-2, the two uppermost layers, 1 and 2, are composed of silty sand containing more than 70 per cent sand and varying proportions of silt, clay being present to the extent of 1 to 2 per cent only. Layer 3 (represented by sample 5) contains coarse and medium sand and 22 per cent silt. The implementiferous layer, 4 (represented by samples 6 to 11), is composed of silty sand, the proportion of silt ranging from 23 to 45 per cent, without any appreciable amount of clay; only sample 7 contains 23 per cent silt and 10 per cent clay. The lowest part of layer 5 represents clayey sand, with 9 per cent clay, 24 per cent silt and 67 per cent sand.

Layers 1 and 2 do not contain pebbles or gravels, and there is no clear evidence of any bedding or sorting, but layer 3 has in its lower part pellety gravel embedded in yellowish silty sand which suggests a sorting of grains. The limonitic patches so marked in layers 4 and 5 are very rare in this layer. Layer 4, which is the cradle of the lithic industry, contains pellety gravel with marked reddish patches. Occasional patches of deep black weathering around the peripheries of dark pellets are also noticeable. The implements, generally made of quartz, chalcedony and chert, are easily detachable and show no sign of cementation or weathering. The first three layers, 1, 2 and 3, are conformable to one another; there is therefore no evidence of any long period of erosion intervening between them. However, there is a distinct break at the bottom of layer 3. Layer 4, as will be seen later, coincides with a climatic oscillation from pluvial to drier conditions. Layer 5 is composed of clayey silty sand with occasional fragments of weathered rock.

It was observed that the top 4 to 5 in. of layer 4 did not yield any tools, their provenance being the lower part of this layer. Layer 5 was also found to yield a few tools; but they were erratics, having infiltrated through fissures and cracks from layer 4 above. The evidence for the presence of cracks and fissures was recorded by the excavator (above, p. 13).

The excavation did not reveal any unweathered substratum even at the lowest levels, but the whitish gritty material from layer 5 of Trench BBP-1 seems to have been derived from a coarse sandstone, evidence of which has been furnished by the railway-cutting within a furlong of Trench BBP-2. Samples collected from this cutting have been found by chemical and petrographic examination to be decayed sandstone, the grains of quartz having been deprived of their cementing material with the result that they have become very friable and cohesionless. The quartz-grains are angular to sub-angular and do not show any frosting or polish on the surface; however, evidence of opaline silica forming on the surface of quartz-grains is clear. The samples resemble Atagarh sandstone, and it is very likely that the pre-microlithic layers encountered in the excavation have been derived from the weathering of this sandstone.

(ii) *Microscopic examination*

For the study of surface-features, shape and size of sand-grains, the samples were leached with conc. HCl to remove cementing material and to produce sand-grains free from clayey material. The grains of sand were thoroughly washed with water and dried. They were then mounted in Canada Balsam and examined by transmitted light.

They were also examined under vertical illumination for studying the nature of their surface.

The quartz-grains from layer 5 of Trench BBP-2 (sample 13) are mostly angular; a few grains show some roundness. Some grains show milkiness and seem to be coated with opaline silica. The quartz-grains in another sample (12) from the same layer also show almost the same features. The grains show the waxy lustre of quartz, free from frosting but occasionally with some polish. The opaline quartz preponderates in the finer grades, while crystalline quartz represents the greater part of the coarser grade.

Similar features are observed in sand-grains from different layers of the two trenches. The sand-grains from layers 1, 2 and 3 of Trench BBP-2 and those from layers 1A, 1B and 1C of Trench BBP-1 show similar angularity and sub-angularity, but the evidence for the presence of gloss or polish on the quartz-grains is not so clear. In view of the sub-angular quartz-grains constituting the bulk of the sand from the two trenches and the absence of frosting and some evidence of polish it seems that the quartz-grains were water-laid. It is likely that the fluviatile quartz-grains in the upper layers of the two trenches were subjected to some wind-activity, as evidenced by the lack of polish and the presence of a slight surface-frosting, but transportation by wind had not proceeded so far as to produce a complete rounding of quartz-grains which is characteristic of the *Teri* sand of south India.

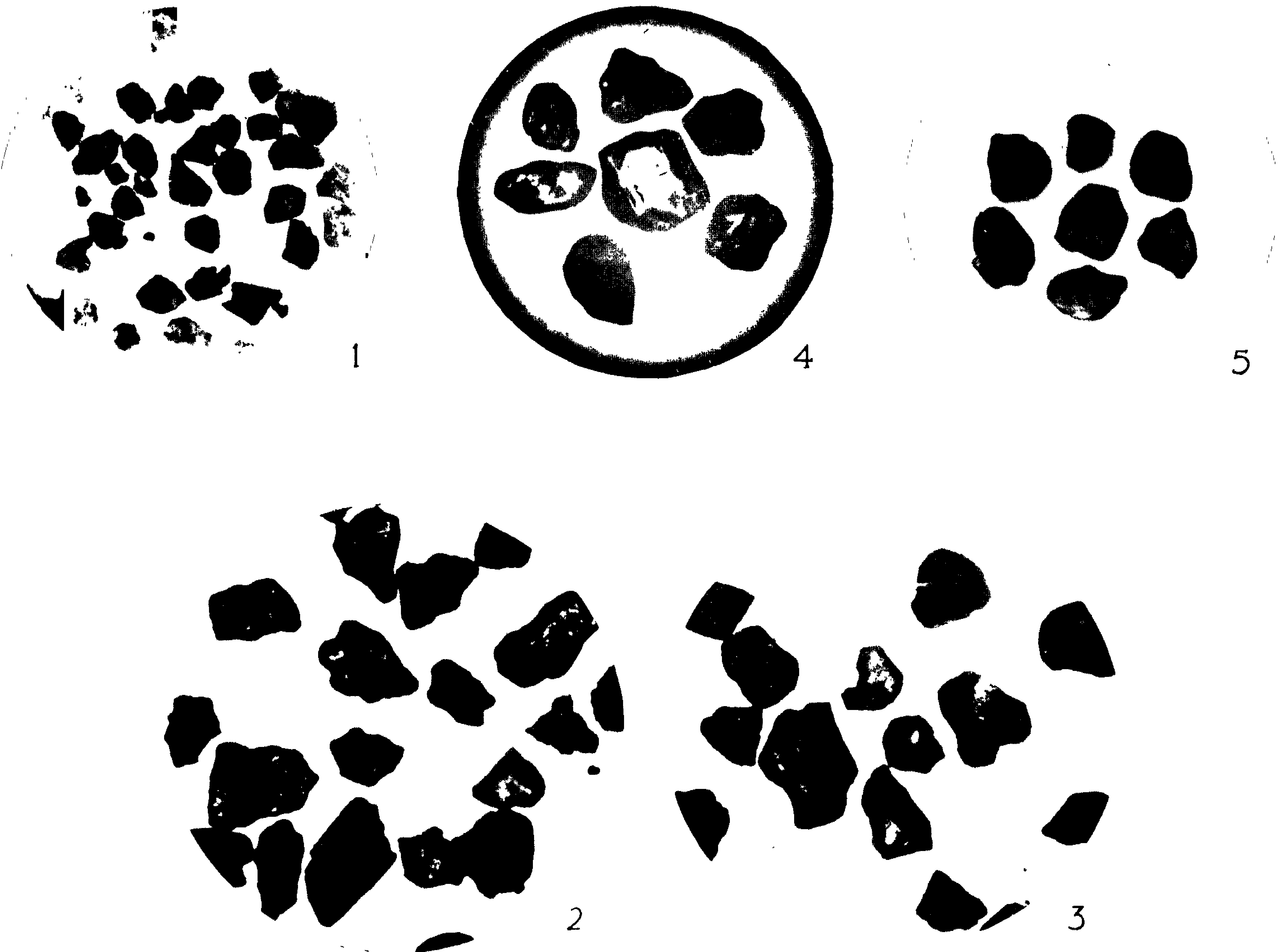
Three photomicrographs showing these characters of quartz-grains are reproduced here (pl. XI, *1-3*). The other two photomicrographs (pl. XI, *4* and *5*) illustrate the *Teri* sand from south India.

(iii) *Chemical analysis*

All the samples were subjected to detailed chemical analysis including the determination of humus, phosphate and calcium carbonate. Phosphate was not found in any of the samples, while organic matter was found to be of the order of ·04 to ·23 per cent. This was to be expected, as the region had been subjected to intense weathering under hot and moist conditions. Further, the land-surface was later exposed to hot and drier conditions which did not favour the development of a thick vegetation-cover, the soil also being not loamy enough to encourage such growth. The samples do not show any effervescence with HCl, indicating that lime, if originally present, has been completely leached out from the layers.

The results of chemical analysis are recorded in Tables 5 and 6.

From the data presented in Table 5, it is seen that in Trench BBP-1 there has occurred a considerable leaching of alkalies and removal of silica from, and an accumulation of the sesquioxides in, layers 1B and 1C, which overlie the implementiferous horizon. This marked translocation of the elements indicates a long period of weathering to which these layers have been subjected. The silica-alumina ratio, Sa value according to Marbut, not only confirms these conclusions but also serves to cross-check them. The values show its marked diminution from layer 1B to 1C. The lower layers, 2 and 3, show a much pronounced leaching of silica and concentration of alumina. The pre-microlithic phase is marked by an intense weathering under hot and wet conditions. The weathering of the deposit overlying the habitation-layer, on the other hand, indicates milder conditions tending towards a comparatively dry phase when a thick vegetation-cover had little chance to develop on the surface due to increasing wind-activity.



Photomicrographs showing surface-features of quartz-grains: 1, *BBP-1, layer 5, lower, reflected light* × 11 ; 2, *BBP-2, layer 4, lower, 4 ft. 1 in., transmitted light* × 25 ; 3, *BBP-2, layer 5, lower, transmitted light* × 25 ; 4, *Teri sand, transmitted light* × 6 ; 5, *Teri sand from Tirunelveli sand-dune, reflected light* × 6. *See page 44*

TABLE 5

CHEMICAL ANALYSIS OF SOIL-SAMPLES FROM TRENCH BBP-1

Layer ...	*1B*		*1C*					*2 (implementiferous)*				*3*			*4*	*5*	
Serial no. of sample ...	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*
Depth below surface ...	*5"*	*6½"*	*10"*	*11"*	*1'4½"*	*1'10"*	*1'½"*	*2'1"*	*2'2½"*	*2'5"*	*2'7½"*	*2'9"*	*4'2"*	*5'9½"*	*6'11"*	*7'8½"*	*10'1"*
Percentage composition:																	
Silica (SiO_2) ...	87·00	92·08	84·20	84·40	81·90	80·51	84·08	84·30	80·50	81·40	79·33	70·90	69·60	75·85	76·20	79·07	78·08
Alumina (Al_2O_3) ...	3·35	3·61	6·45	6·53	8·35	10·84	9·88	8·79	8·54	9·88	10·55	13·96	11·06	13·70	13·69	10·39	11·36
Iron oxide (Fe_2O_3) ...	1·80	1·45	2·40	2·73	2·39	3·10	1·66	3·66	3·40	4·26	2·94	7·80	7·11	5·89	0·41	2·80	0·61
Lime (CaO) ...	0·85	0·78	1·09	0·95	0·83	0·84	1·21	0·70	0·81	0·65	0·65	0·91	1·30	0·57	0·04	0·15	0·08
Alkalis (K_2O+N_2O)	4·98	1·86	2·95	2·25	...	2·8	2.95	1·73	1·64	3·53	4·92	2·78	...	2·08	4·40	2·08	5·40
Loss on ignition ...	1·20	1·40	1·90	...	..	3·50	2.48	2·52	3·70	2·06	...	2·84	2·72	3·60	3·69	3·65	5·08
Silica-alumina ratio, ($SiO_2:Al_2O_3$) Sa value ...	44·15	43·36	22·19	21·90	16·67	12·61	14·47	16·30	61·01	13·99	12·77	8·62	10·69	9·40	9·45	12·94	11·68

TABLE 6

CHEMICAL ANALYSIS OF SOIL-SAMPLES FROM TRENCH BBP-2

Layer	*1*	*2*			*3*	*4* (*implementiferous*)						*5*	
Serial no. of sample ...	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
Depth below surface ...	*4½"*	*10"*	*1'7"*	*2'4½"*	*2'9½"*	*3'4"*	*4'*	*4'1"*	*4'2"*	*4'2½"*	*4'4"*	*4'11"*	*5'3"*
Percentage composition:													
Silica (SiO_2)	90·72	90·50	86·88	83·83	84·70	81·40	79·79	81·70	81·80	79·79	78·50	78·87	78·63
Alumina (Al_2O_3) ...	3·66	4·50	6·49	7·14	4·89	9·41	10·21	9·02	10·81	10·74	10·94	11·68	12·31
Iron oxide (Fe_2O_3) ...	3·66	3·80	2·21	2·67	3·97	4·04	4·13	4·44	3·93	4·05	5·15	4·94	3·61
Lime (CaO)	0·57	0·17	0·78	0·90	0·25	0·46	0·72	0·64	0·73	0·52	0·96	0·50	0·86
Alkalis (K_2O+N_2O) ...	...	...	...	2·40	3·40	2·14	0·89	1·82	1·47	...	0·33	2·10	...
Loss on ignition ...	1·44	2·35	1·98	2·29	2·05	3·12	3·28	2·87	2·18	3·89	3·52	2·30	3·59
Silica-alumina ratio (SiO_2: Al_2O_3) Sa value ...	42·17	34·19	22·73	19·96	29·44	14·71	13·28	15·37	12·85	12·61	12·19	11·48	10·85

The results of chemical analysis of the samples from Trench BBP-2 (Table 6) are in close accordance with those already described. The post-microlithic layers, 1 to 3, show a marked leaching of silica and accumulation of alumina. The silica-sesquioxide ratio (SiO_2: Al_2O_3+Fe_2O_3) as well as the silica-alumina ratio (Sa value) tend to diminish as lower deposits are reached. The layers underlying the implementiferous stratum show a pronounced leaching of silica and concentration of the sesquioxides.

C. Discussion

From the above results we are led to the conclusion that the pre-microlithic strata, viz. layers 3, 4 and 5 of Trench BBP-1 and layer 5 of Trench BBP-2, were produced under conditions of large quantities of moisture and a high mean annual rainfall with a downward percolation of water. The strata are very low in humus, highly leached and largely composed of silica and the sesquioxides. The weathering is distinctly lateritic and the bed-rock has been intensely decomposed to great depths. All this might have happened during the last pluviation of the Pleistocene; and while this process lasted dense tropical forests similar to those of Malabar must have existed in this region. The presence of such forests probably did not encourage the prehistoric man to inhabit this region.

When the climate became comparatively dry, the lateritic land-surface did not have an adequate protective mantle of vegetation because of infertile soil and high temperature; and as wind-activity increased, transportation of rock-débris assumed considerable proportions. This was aided by the heavy seasonal rainfall which scoured away the top soil of the land-surface. This period probably also witnessed the formation of hard iron pan such as encountered in layer 3 of Trench BBP-1. The ground water-level must have been relatively deep and the dry spell encouraged an upward movement of water. Below the surface, therefore, an accumulation of colloidal iron oxide assumed the form of the hard pan. The pan evidently formed a crust parallel to the contemporary land-surface. Layer 3 thus represents an undisturbed weathering horizon over the bed-rock, the upper horizon having been eroded away. This eroded surface was the cradle of the microlithic culture, perhaps some time at the beginning of the Holocene.

In the post-microlithic times, as the climate tended more and more towards semi-aridity, the site witnessed strong and frequent winds. The onslaught of these winds had a pronounced effect owing to the sparseness of vegetation, and the loose surface-soil, which was crumbling under the action of ascending waters, was subjected to aeolian erosion. The rainfall was not even but seasonal, tending to be concentrated in between long spells of dry weather. Since there was little binding of the surface owing to scanty vegetation, large quantities of rock-débris and soil were transported. The aeolian character of the transported material, however, prevailed over its fluviatile character as the quartz-grains from the post-microlithic layers have been found to show marked frosting, a characteristic of aeolian sand. This post-microlithic phase, represented by layers 1B and 1C of Trench BBP-1 and layers 1, 2 and 3 of Trench BBP-2, was therefore marked by a drier climate. These layers also seem to have undergone an appreciable weathering, as a translocation of minerals from the upper horizons to the lower layers has been amply demonstrated by chemical analysis. The colour of the weathered layers, which is yellow to reddish-brown, also suggests an incomplete oxidation of iron compounds. This 'drift' deposit, therefore, does not represent a mature soil, the soil-forming processes having been constantly disturbed and interrupted by continuous deflation and deposition of fresh material.

In the course of excavation it was observed that both the sites were free from pottery (above, p. 15). There is, therefore, clear archaeological evidence that unlike other

microlithic industries associated with pottery and even metal, the lithic industry of Birbhanpur belonged to a pre-pottery phase. The geochronological evidence adduced here, although inconclusive so far as the absolute chronology of the site is concerned, places this microlithic culture in the comparatively mild and dry phase following the lateritic weathering, and though it would be difficult to fit this phase firmly into the acknowledged time-scale of climatic chronology without further geological investigation, the probability is that it may be assignable to the beginning of the Holocene.

This picture of the environmental conditions prevailing at Birbhanpur in prehistoric times is based on the geochronological investigation discussed above. Heavy-mineral analysis, already under way, may help to clarify the picture.

D. Acknowledgements

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STUDIES IN THE STONE AGE OF NAGARJUNAKONDA AND ITS NEIGHBOURHOOD[1]

By K. V. Soundara Rajan

CONTENTS

1. INTRODUCTION

NAGARJUNAKONDA (lat. 16°31′N.; long. 79°14′ E.) is a picturesque valley situated in Palnad Taluk of Guntur District in Andhra Pradesh. Its historical importance is derived from its having been the seat of the Ikshvāku kings in the opening centuries

[1] Originally submitted, in a briefer form, to the Fortyfourth session of the Indian Science Congress, Calcutta (January, 1957).

of the Christian era—verily a golden age alike for the art-history of Āndhra as for southern Mahāyāna Buddhism. The valley teems with ruins of countless Buddhist edifices. Comprising an overall area of 8 square miles, girt by high hills on the north, east and south and flanked by the swift-flowing Krishna on the west and again partly on the north (fig. 1), it commands a natural strategic situation which lent it a favoured position in ancient times.

In addition to the early historical Buddhist monuments, the valley also contains megalithic monuments, mainly of the cairn-type outwardly and often enclosing a cist-tomb in a pit-grave within, obviously a part and parcel of the megalithic culture of the peninsula, with the third century B.C. as the anterior limit.

That neolithic artefacts should occur in the valley is very natural, as the trappoid raw material, a lithological adjunct of the Cuddapah system, besides other metamorphosed sandstones, etc., is available in plenty. That the artefacts were locally fabricated here and not imported is fully attested by the occurrence of a number of finished and incomplete tools in many forms and flakes on basaltic and other soft materials on the surface, particularly on the high ground to the south-east of the Tellarallabodu hill (marked F in fig. 1). This neolithic industry, associated with bits of copper and therefore chalcolithic in character, is dealt with in some detail below (pp. 93 ff.).

Although it is very reasonable that palaeolithic artefacts should as well be available in the valley which has all the raw material for the manufacture of such artefacts, it was only in 1956 that the author noticed the occurrence of palaeoliths in all the stages of typological evolution, beginning with the crude handaxe and unifacial and bifacial pebble-tool to the diminutive Upper Palaeolithic scraper, blade, burin, etc., which culminated in a non-geometrical microlithic industry on chert, agate and jasper. All this naturally lends the region a special importance, particularly as encouraging results have been achieved in Stone Age studies in the neighbouring District of Kurnool, first by Burkitt and Cammiade in 1930 by their discoveries of a full range of typological evolution and climatological changes in this area which led to the postulation of a probable pluvial and interpluvial cycle, corresponding to the cycle of glaciations and interglaciations in the Himalayan foothills, as later propounded by De Terra and Paterson, and subsequently by the Department of Archaeology in recent years. Thus, the tool-types occurring in the Nagarjunakonda valley would, typologically, be a natural extension of those available at the Kurnool sites and would demand a scrutiny of their character and variations. The fact that within the valley itself all the stages (Series I to IV of Burkitt) are available would further indicate a continuous inhabitation of the valley by the Stone Age man.

The present study of the artefacts, both palaeolithic and microlithic, in which upwards of one hundred and thirty tools have been dealt with, was done by the author while he was engaged primarily in the excavations being conducted in the valley now. In the following pages, an assessment is made of the main technological and typological features and affinities as far as can be defined from the limited, though representative, collection under study, with a view chiefly to emphasize their evolutionary aspect. While only a limited number of tools have been individually described, the general conclusions are based on a larger collection made by the author.

A palaeolithic industry, accidentally discovered by the author near the village of Karempudi (lat. 16°26′ N.; long. 79°43′ E.), 32 miles to the east-south-east of Nagarjunakonda (fig. 2), is also dealt with below. Typologically, the litho-cultural development at Karempudi stopped with the beginnings of the Levallois flaking stage.

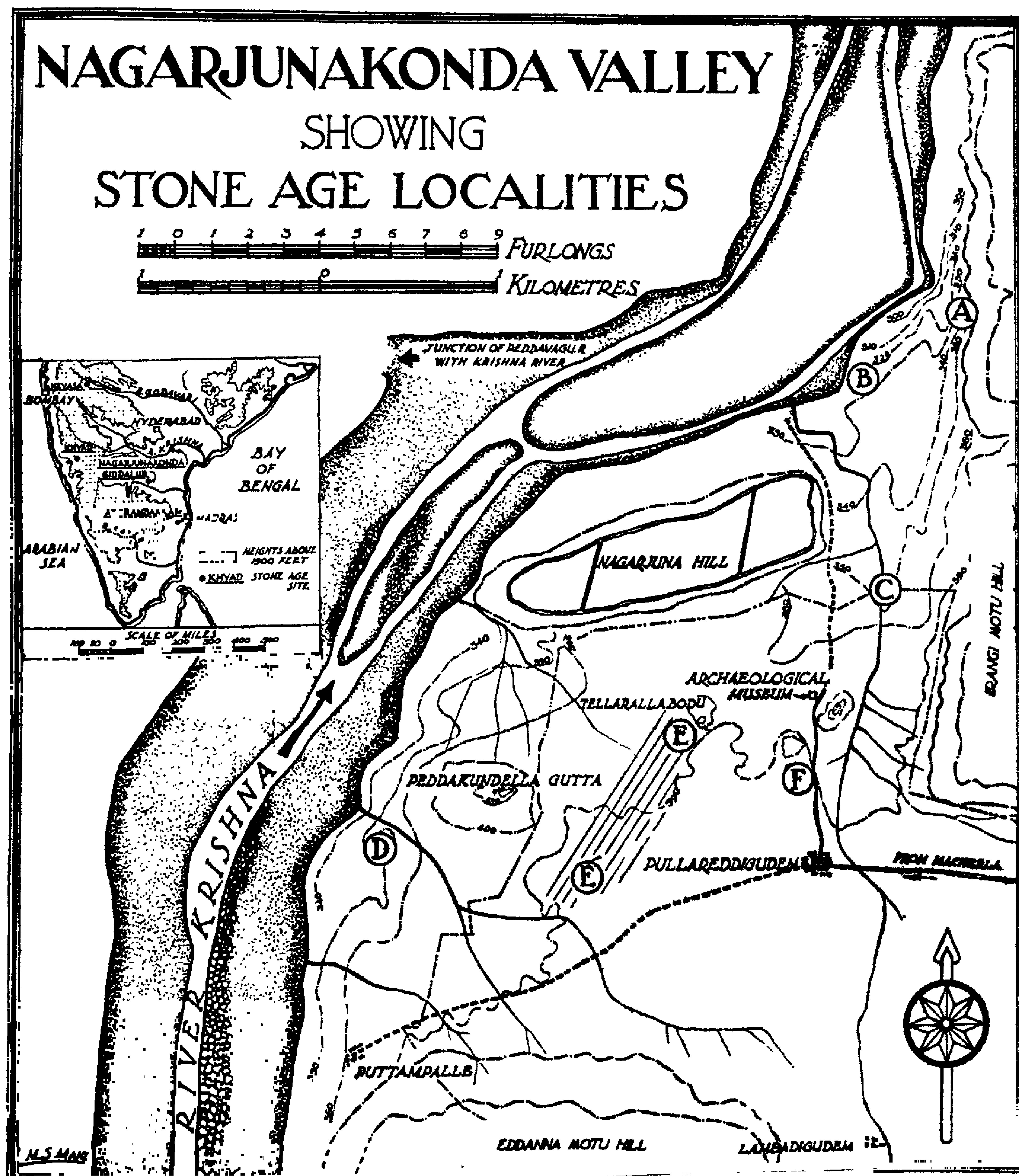

NAGARJUNAKONDA VALLEY
SHOWING
STONE AGE LOCALITIES
FURLONGS
KILOMETRES
JUNCTION OF PEDDAVAGU R WITH KRISHNA RIVER
BAY OF BENGAL
ARABIAN SEA
HEIGHTS ABOVE 1500 FEET
KHYAD STONE AGE SITE
SCALE OF MILES
NAGARJUNA HILL
ARCHAEOLOGICAL MUSEUM
TELLARALLA BODU
PEDDAKUNDELLA GUTTA
PULLAREDDIGUDEM
FROM MACHERLA
RIVER KRISHNA
BUTTAMPALLE
EDDANNA MOTU HILL
LAMBADIGUDEM
BANGI MOTU HILL
A
B
C
D
E
F
M.S.MANI

FIG. 1

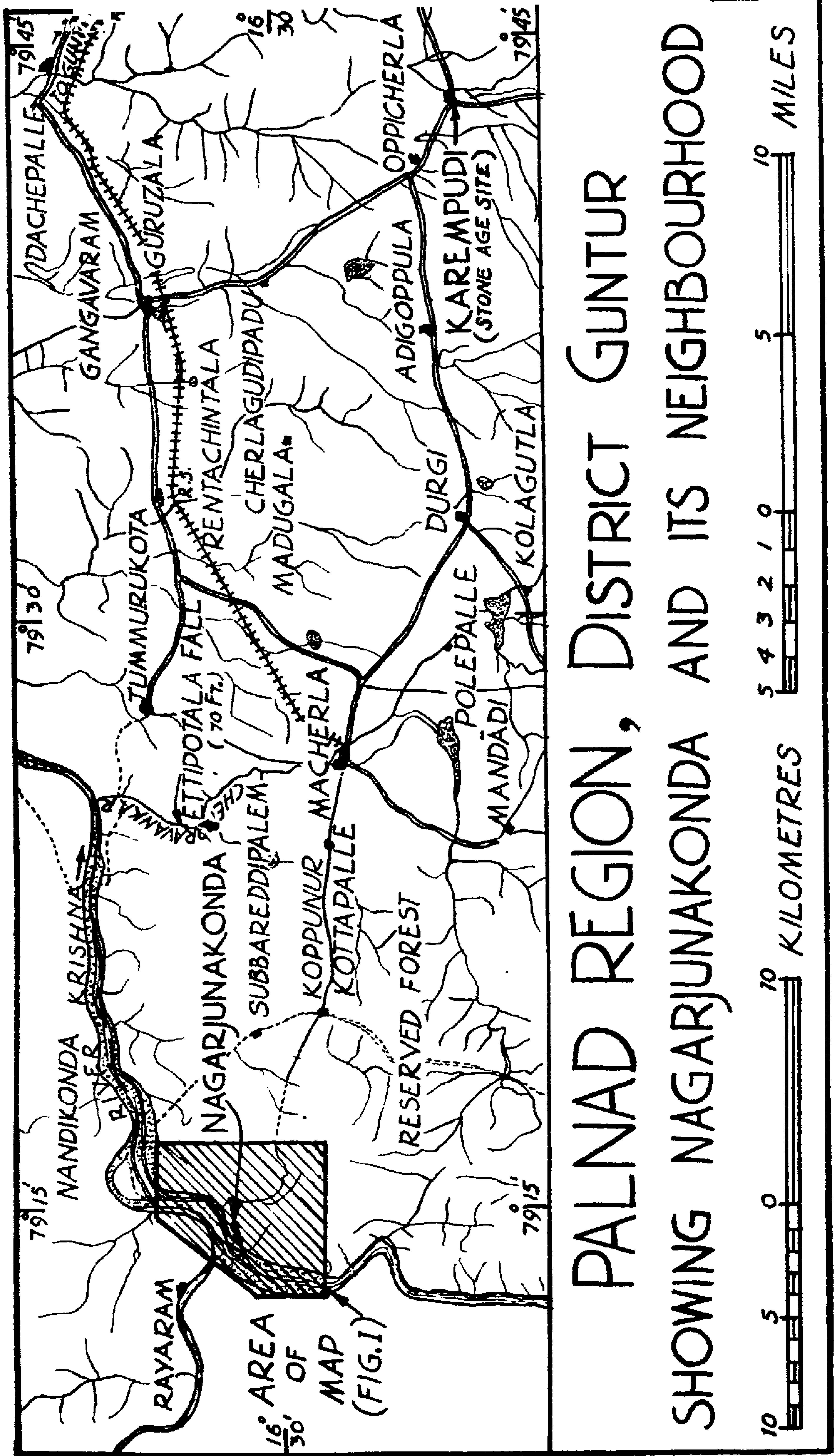

PALNAD REGION, DISTRICT GUNTUR
SHOWING NAGARJUNAKONDA AND ITS NEIGHBOURHOOD
KILOMETRES
MILES
AREA OF MAP (FIG.1)
RAYARAM
NANDIKONDA
KRISHNA RIVER
NAGARJUNAKONDA
SUBBAREDDIPALEM
KOPPUNUR
KOTTAPALLE
RESERVED FOREST
MACHERLA
ETTIPOTALA FALL (70 FT.)
TUMMURUKOTA
RENTACHINTALA
MADUGALA
CHERLAGUDIPADU
GANGAVARAM
GURUZALA
DACHEPALLE
DURGI
KOLAGUTLA
POLEPALLE
MANDADI
ADIGOPPULA
KAREMPUDI
(STONE AGE SITE)
OPPICHERLA
79°15'
79°30'
79°45'
16°30'

FIG. 2

2. THE PALAEOLITHIC INDUSTRY OF NAGARJUNAKONDA

A. Geology (fig. 3)

The prevailing rocks of the hills in the valley fall under the Cuddapah series at the Srisailam stage and belong to the Purana group of India, corresponding in age to the Eparchaean interval, and rest on an unconformity. With their type-area in Cuddapah District in Andhra Pradesh, they are of great thickness and comprise indurated shale, quartzite, sandstone and limestone, with occasional trappoid[1] or doleritic beds and tuffs. Petrologically, they show a great amount of regional metamorphism, tectonic plication and deformation. Banded ferruginous jaspers are also one of their features. While the granites are largely subterranean excepting in hills and outcrops here and there, like the Peddakundelagutta hill, the quartzites alone form the bulk of the high hills and include crushed or puckered laminated blocks of the big hills as well as the white dyke-quartz variety as the Tellarallabodu hillock. In addition, the river had transported a substantial load of fine and even-grained quartzitic shingle, besides smaller pebbles of jasper, agate, chert, etc., from the Dharwar formations in its upper reaches near the Tungabhadra zone, and these provided copious raw material for fabricating tools.

B. Physical setting

The physiography of the valley is characterized by crystalline rocky substratum and high rocky spurs, with a graded river flowing on a rocky bed amidst hills rising on its banks. The general slope within the valley is from the south towards the north and north-west. The topography on the eastern side of the valley is distinguished by a long perpetual nullah starting from off Lambadigudem and, with a more or less due north course across the valley along the base of Phirangimotu hill, debouching into the Krishna near the north-east corner of the Nagarjuna hill. The stratigraphical sequence of the valley-floor is mainly that of a sub-angular pebbly and disintegrated granular rock-fragments, resting over hard rock and overlain by a thick layer of *kankar*-mixed earth, highly consolidated on the surface at places, which, in turn, is capped by a cultural deposit, the thickness of this last deposit varying from 3 to 6 ft. according to the location of the area in relation to the findspots of early historic vestiges.

Terraces, the abandoned flood-plains marking the previous higher stages of a stream and sometimes interlocking its career with Stone Age relics, are not clearly apparent in the valley. This is due to the fact that the valley is nestled among high rocky spurs, and the river Krishna is led by geomorphic structures along the fringe of the valley without leaving any substantial impress on it. The valley attracted the Stone Age man owing to the secluded habitat that it provided, which factor makes the problem of the reconstruction of Stone Age ecology all the more complex and makes the entire valley one vast open-air station. As a mere typological conspectus of the scattered and disarticulate lithic assemblages of the valley would lead us nowhere in the absence of fairly reliable environmental data, an attempt is made here to tie up the general trend of tool-evolution to some workable physiographic basis. In this connexion, two features in the valley deserve our attention.

[1] This formed the source-material for the neolithic industry at Nagarjunakonda (below, p. 94).

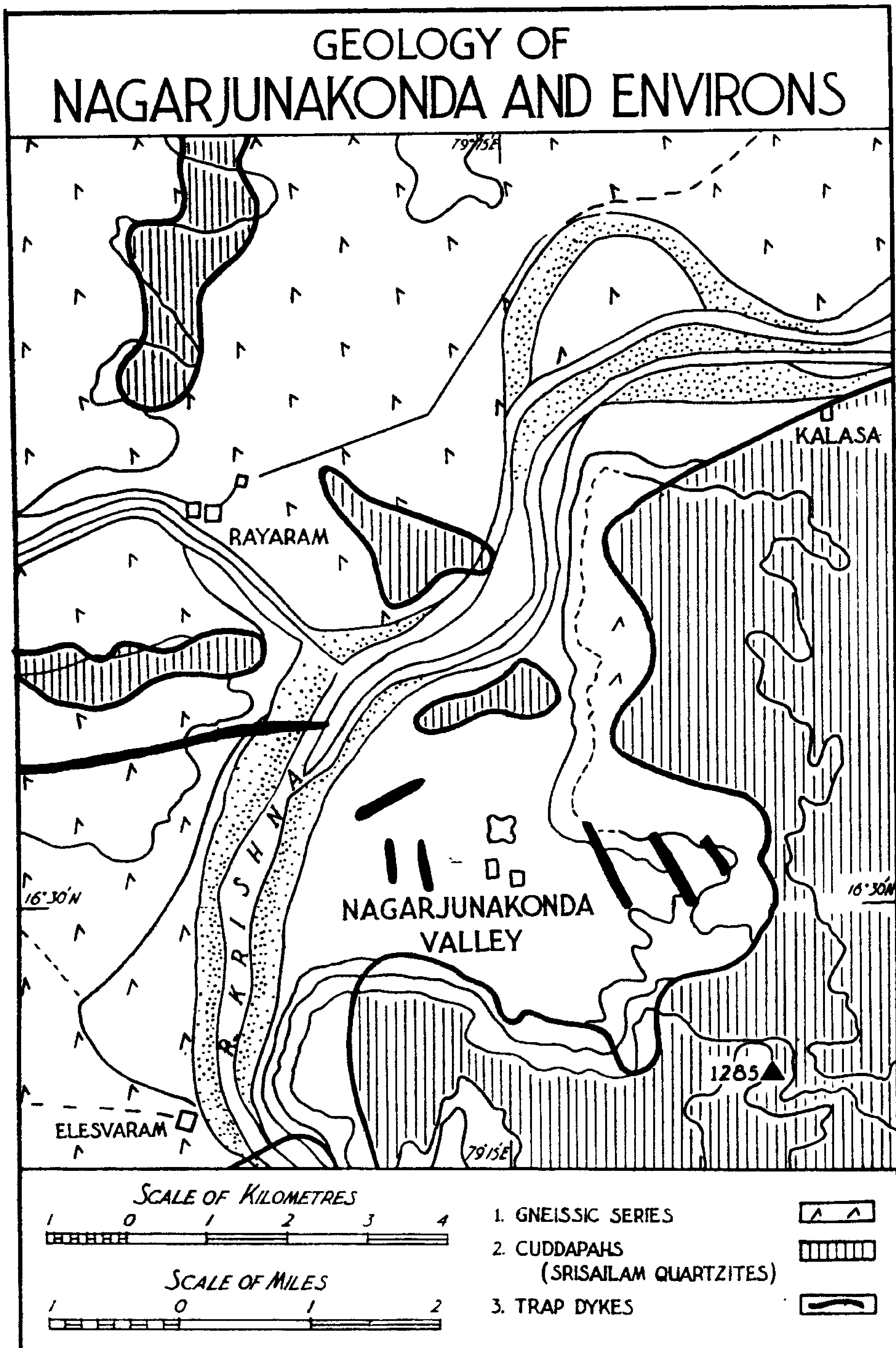

GEOLOGY OF
NAGARJUNAKONDA AND ENVIRONS
79°15'E
RAYARAM
KALASA
16°30'N
16°30'N
KRISHNA
NAGARJUNAKONDA
VALLEY
1285
ELESVARAM
79°15'E
SCALE OF KILOMETRES
1 0 1 2 3 4
SCALE OF MILES
1 0 1 2
1. GNEISSIC SERIES
2. CUDDAPAHS
(SRISAILAM QUARTZITES)
3. TRAP DYKES

Fig. 3

Along the north-eastern corner of the valley, where the Phirangimotu hill projects far north beyond the Nagarjuna hill as a promontory, thus forcing the river to meander wide before recovering an easterly course, a triangular pan is afforded, wherein are noticeable a series of morphological steps, apparently the result of erosion. Of these, local observation lends significance to two Localities (marked A and B in fig. 1), owing to the concentration of tools of a particular character in them.[1] On the partly-eroded surface of Locality A, about 340 ft. above the mean sea-level and about 42 ft. above the river-bed, a rain-gully has exposed the tool-deposits, the tools, almost entirely comprising Abbevilleo-Acheulian handaxes and cleavers and some pebble tools, occurring in a loose matrix of pebbles over a disintegrated rocky soil. Flakes and flake tools, particularly of the Levallois industry, were entirely absent in the deposit. In fact, the tools themselves were on large-sized pebbles; cleaver no. 16 (fig. 8; pl. XV) was picked up from this deposit. It is likely that a few tools of early facies, perhaps originally lying further up, came down into this deposit; but it could not have drawn into it any tool of a more evolved character. On the other hand, the other Locality, B (about 320 ft. above the mean sea-level and about 22 ft. above the river-bed), which lies to the south-west of Locality A and covers a wider area, was noticed to be the venue of flakes and flake tools, particularly of the Levallois industry, and indeed yielded such tools in great profusion almost to the exclusion of any bifaces. These tools, however, lay on the ground, the stratigraphy of which was composed of soil of 2 ft. to 3 ft. thickness over disintegrated Archaean rocks.

Thus, we have two litho-morphological stages in the history of palaeoliths, which are reinforced by the occurrence of genuine cemented gravels in the nullah in Locality C (fig. 1) described below (p. 56); with these composite environmental data, the lithic industry might be saved from a mere taxonomic tangle.

There is yet another field-observation which would merit mention. It has already been stated that the tools were found on the surface of a great part of the valley. However, it was also seen that certain parts of the valley yielded a consistently rich harvest in specific groups of tools and were relatively poor in others. As a result of a repeated traverse across and around the valley for a scrutiny of a plausible rationale behind the surface-scatter of the tools, the author found that Locality D (fig. 1) had practically none save pebble tools and large and prominent-bulbed Clactonian flakes and cores to present, and rarely did one meet with an Abbevillean-like handaxe here. The situation of this Locality is along the 350-ft. contour-slope of the main river from the junction of the dry nullah found at the foot of the disintegrated quartzitic high ground with the river right along downstream for a few furlongs. It would seem to the writer that the spot, together with the north-east tip of the valley, may represent the earliest venue of the Stone Age man in the valley, prior to his clearing and entering the dense forest-cover in the interior. The level of the Locality also would support this assumption.

Immediately to the west and south-west of Lambadigudem runs a nullah which forms part of the upper reaches of the nullah-system here. The survey of the gravel-sections and bed of this nullah in the vicinity for a stretch up to the very foot of the Eddannamotu hill brought to light interesting data on the early phase of man's activities in the valley. The polygenetic gravels, mainly derived from the shaley and angular quartzitic talus, have preserved a Clactonian industry formed of very large thick elementary flakes with high-angled plain striking platforms and rippled flake-scars and with little or no secondary trimming in most cases. No. 105 (fig. 6; pl. XIII A) is particularly

[1]Actually, excluding the microliths, a major part of the collection under study is composed of tools picked up from Localities A, B, cemented gravel-bed C, D and E-E.

illustrative of the primitive free-flaked nature of the tool with large and rather shallow flake-scars. The industry apparently accompanied a crude core-tool industry of the early Abbevillean type, of which fewer specimens, chiefly of rostroid type, were found. As we descend further north along the nullah, the banks have some tools revealing a development as indicated by the occurrence of a Victoria West tool with the underside having a series of marginal scars and a typical large side-blow scar opposite intersecting them all (no. 106: fig. 6; pl. XIII B).

This entrenched presence of the early Clactonian flakes and early core tools, devoid of any pebble element, might suggest that the early phase of Stone Age man in the valley was twin-faceted. On the one hand, the men who settled near the main Krishna river near Localities A and D would have had access to the great supply of fine riverine shingle for making pebble tools, while, on the other hand, those who ventured along the nullahs upstream and settled near the base of the hill-saddles, where a plentiful supply of shales and quartzitic gravel was available in the talus of the hill-formations, applied themselves to the Clactonian and primitive core tools of rostroid and Victoria West types. Their further advancement was apparently co-extensive with the Acheulian of the rest of the valley, since by that time they had actually left the distant hill-slopes and converged towards the more interior areas mainly along the nullah-banks. This reasoning would not go against any known data and would indeed supplement and strengthen them and place the early Abbevillean, the early Clactonian and the pebble tools in a more or less same chronological horizon

As was observed, tools of the handaxe facies and flake tools are concentrated in the north-east corner of the valley, along the best part of the foot of the Phirangimotu hill. Again, it was a careful and clear observation that the blade-flake and burin group was particularly prolific around the Tellarallabodu hill, over Locality E (fig. 1), as suggested by the profusion of flakes and blades in different stages of completion in this area. This may again indicate that by the Upper Palaeolithic times, with a technological evolution firmly achieved, the knappers could confine themselves to limited areas in the central high ground and keep themselves busy with the raw material garnered around them. This also holds good for the high ground covered with quartzitic gravel to the south-west of the Tellarallabodu and south-east of the Kundellagutta hill (Locality É), since Upper Palaeolithic blades and scrapers are found here too in a very high frequency.

Although the surface-occurrence of the artefacts is spread over a large part of the valley, mainly due to the cultivation of fields over many years, it is specially governed by the location of the nullahs which cut across the western and north-eastern flanks of the valley. Their banks, particularly on the lower reaches, are characterized by the scatter of gravels and also artefacts. Of these, special mention must be made of the long nullah already mentioned (p. 53), which would appear to have played its part in the palaeolithic times. At a few of its meanders and junctions with feeder-nullahs, it presents in miniature the broad climatic oscillations in those times.

The most interesting stretch of its section is situated in the south-east foot of the Nagarjuna hill, where the nullah is joined (at Locality C) by a smaller one coming from the west, near the road-crossing leading to the Buddhist University area. The basal gravels (fig. 4; pl. XII) at the foot of the western bank-section here are in a highly-cemented state and are a calcareous conglomerate full of sub-angular blocks and pebbles occurring for a stretch of nearly 50 ft. Coarse chunks of calcareous gravel, besides pebbles of different sizes, also stud the bed of the nullah, directly overlying the rocky bed of the stream. This would indicate that the career of the stream started when the surface was an uneven rocky bed, over which the coarse gravels and disintegrated rocky fragments were

spread during a wet phase. The basal gravels of the section would have been laid during the succeeding dry phase when the stream aggraded and unloaded its gravelly deposit on the banks. A hard cemented gravel-layer is found on the corresponding east bank also at this point to an equal thickness. This would be coincident with the first appearance of man as an arteficer at Nagarjunakonda, for two implements, which would have come only from the lowest gravel or the next, as *kankar*-grit was sticking hard to the tools, were recovered from the cemented blocks in the bed.

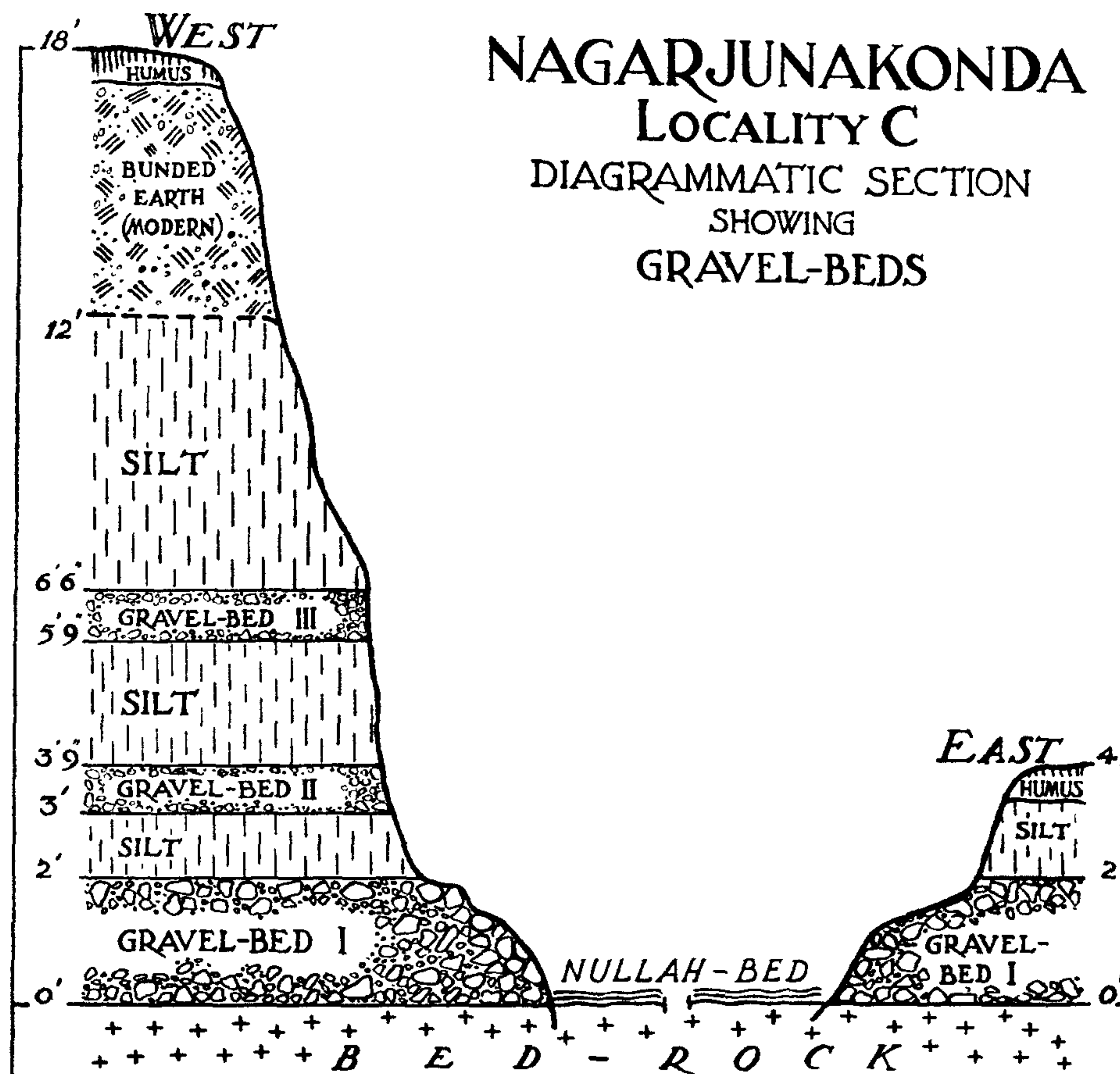


FIG. 4

The lowest gravels are overlain by pale whitish *kankar*-mixed silt indicating a second wet phase, which again underlies the second gravel-bed not so hard as the lower, the result of the second cycle of aggradation of the nullah. This gravel is capped by a silt-deposit attesting to a third wet phase, and the latter, in its turn, underlies a third and thinner gravel-bed, the outcome of the third aggradation of the nullah. This last is covered by a thick mantle of silt as well as earth—the latter apparently forming a made-up dump—and is ultimately topped by a humus-cap, the result of vegetation. The total height of the nullah-section here is nearly 18 ft. Two artefacts (nos. 26 and 27: fig. 9; pl. XVI B) were extracted from the cemented gravel blocks in the nullah-bed: the first a neat ovoid scraper on a medium-to-large flake, and the second a thin leaf-shaped flake of a similar size with the dorsal right half trimmed as an asymmetric cutting tool or scraper. A third tool (no. 8: fig. 6; pl. XIV B), removed from the rather loose third gravel-layer, was an

incomplete Early Acheulian handaxe of less-than-medium size. It might perhaps have got re-deposited from the nullah-bed during the third aggradational phase.

The three gravel-beds might represent the evolutionary period to the end of the Lower Palaeolithic, though it would need a larger number of tools *in situ* to establish this view.

C. General cultural elements

As has been mentioned above (p. 53), there is a plentiful supply of raw material in the valley. It is of three kinds: fine-grained quartzitic pebbles, which are abundant on the river-bank and are of shades ranging from light-brown to grey, mainly used for Lower-Middle Palaeoloithic tools; fine-grained flinty chert or jaspery quartzite, of limited availability and usage and mainly of a greenish-grey hue, which is chiefly employed for the blade-scraper-burin assemblage; and silicious material of translucent nature, such as chert, agate and jasper, generally of pale amber and chestnut as well as dark colours and occasionally banded, exclusively used in the microlithic tools (below, p. 90).

As a rule, the artefacts made on quartzitic pebbles do not have any weathered cortex and are often of a surprisingly fresh *état physique*; but the flinty variety has often a superficially patinated surface, varying from creamy to yellowish tinge. In a few cases, there is a substantial leaching and weathering of the textures; and in the cases of the silicious rocks mentioned above, there is often a freckling or coarsening of the surface due to a differential dissolution of the soluble silica, as is common in limestone regions. The average size of the silicious pebble is very small, often not exceeding $\frac{3}{4}$ in., the largest being $1\frac{1}{4}$ in.

The palaeolithic assemblage has various characteristic tool-types, viz. the Abbevillean handaxe with a keel-end like a rostrocarinate and equatorial jagged edge, and both round and tabular pebble tools—the facies being a typical feature within the southern Madras handaxe culture, as distinguished from the northern Sohan industry, despite the great mutual likeness (fig. 5; pls. XIV A and XVII A). At this stage of the handaxe industry, we have the jagged-edged, spatulate and, limitedly, cleaver-edged biface as well (no. 61: fig. 6; pl. XVII A), which is the accompaniment to the handaxe in India as in Africa. As the handaxe developed into the neater biface with a thinner section and straighter and sharper edges—the result of resolved flaking and step-flaking—and with a regular pyriform or triangular shape, the cleaver also developed into stages, variously of the chipped bifacial type and the single or double Vaal technique type, the latter—recalling its analogues of south Africa—the result of careful alternate marginal trimming and detachment of large flakes by side-blow knocks from one or both the margins, resulting in a sharp, pronouncedly acute-angled, cleaving edge at the bottom margin of the tool. In these types, both the straight-edged and the oblique-edged tools ('guillotine'-type of Bruce Foote) are available. Concurrent with the evolution of the handaxe is that of the ovate, which also reaches a high degree of perfection, assuming a thin and lenticular section and straight-edged and symmetric oval shape and displaying, in one specimen, the S-twist also (no. 64: fig. 7; pl. XVII A). The advanced Acheulian stage is emphasized, besides, by the occurrence of small neat cordiform handaxes (nos. 13 and 63, the first incomplete: fig. 7; pls. XV A and XVII A), which are typical of the Late Acheulian at many sites in India such as Attirampakkam on the Korttalayar (Madras) and Khyad on the Malaprabha (Dharwar). The pebble and bifacial tools, on the whole, bear considerable affinity to the Chellean-Acheulean of Europe on the one hand and the Pre-Stellenbosch and the Stellenbosch of south Africa and the Oldowan beds I to IV of east Africa on the other.

Of the flake component cognate with the Lower Palaeolithic biface-industry, we have the thick and large Clactonian or 'block-on-block' technique flakes with obtuse-angled striking platform and the flake scraper of the side- and end-types as well as the hollow types, which, with the Middle Acheulian stage, come upon the Levallois or prepared-platform technique flakes with prepared or faceted striking platforms. The cores are of the usual discoid and biconical as well as 'tortoise' types, a few of them being illustrated here (nos. 24 and 101: fig. 9; pls. XVI B and XXI B); one specimen (no. 25: fig. 9; pl. XVI B), also of the Mousterian core-type, has centrally-directed multiple flakescars on the margin and a generally flat body. A triangular flake like an arrow-head, with a plain obtuse striking platform (no. 35: fig. 9; pl. XVIII A), besides many triangular flake tools with peripheral chipping and retouch and plain platforms (nos. 36, 37, 68 and 69: figs. 9 and 10; pl. XVIII), was perhaps struck off such a core. Some of the flakes of less-than-medium size have variously an incipient tang or pseudo-tang and peripheral nibbled retouch for scraper-edge, as well as the scraper-*cum*-perforator devices in the 'hen-beak' form, not unlike that of the Upper Aurignacian end-scrapers of Europe.

Typologically, among the medium-to-small flakes, there is a change as from the Lower Palaeolithic assemblage detailed above (p. 58), in that the material is often different and the technique is that of the developed Levallois, with evidence of minute secondary trimming or retouch, pressure-flaking having been used in some. The tools range from less-than-medium to diminutive sizes and are variously of the side-scraper, end-scraper, hollow scraper, disc-scraper and planning-tool varieties, with awl-points in some. They are further enriched by a blade-and-burin assemblage, the blades often manifesting narrow prepared platforms and clearly indicating, by the thin narrow long ribbon-scars, dished and stepped platforms and delicate retouch that a medium had been employed to transmit the percussion on the platform: in other words, the hammer-technique had, in many cases, been replaced by the punch- and pressure-techniques. There are also some which retain arrow-head shapes on clearly bladish flakes, while others have retouched scraper-edges. Fabricated often on silicious rocks like green or brownish jaspery chert is a group of tools which too have the burin-edge with or without an additional scraper-edge. The occurrence of these burinate tools is of great significance, as they are clearly of the blade-tool accompaniment and are quite apart, in material and size, from the burins which are also available with microlithic artefacts in the valley (below, p. 90). This confers upon the blade-and-burin group an Upper Palaeolithic setting, and the character of the whole group, broadly speaking, would suggest Upper Palaeolithic culture-traits, albeit lacking emphasis owing to the limitations of stratigraphic data. Blades-*cum*-burins have been seen to occur even immediately outside the valley, an illustrated tool (no. 104: fig. 12; pl. XXI C) having neat double transverse spalls meeting double vertical spalls, the rest of the side and bottom edges delicately retouched as scraper-edges. Added to this, we have a few flake-points of triangular and almond shapes with finely-worked edge and tip and occasionally with incipient tang or shouldering. They are mostly unifacially retouched, the lower side usually having a plain flake-scar and rarely having minimum inverse retouch as well. The smallest specimen of this group is less than $\frac{3}{4}$ in.[1]

[1] It has been recently discussed by Krishnaswami and Seshadri that, as held by Vaufrey, the African post-Palaeolithic and Middle Palaeolithic industries comprise mainly a lineal chain of small-tool industries exhibiting great specialization and sprouting from a robust basic Levallois inspiration and ramifying into the microlithic elements ultimately. The Fauresmith-Still Bay-Magosian-Wilton B of east Africa and the Aterian-Capsian-Mouillian (old Ibero-Maurusian) of north Africa are thus to be explained rationally. In a similar way, the Upper Palaeolithic of south

On the whole, the Upper Palaeolithic group in the collection is characterized by blade-flakes, burins and scrapers, the last with a rich variety. The collection from Localities E-É is particularly replete with a wide variety of blade-scrapers, scraper-*cum*-perforators and awl-points on thick triangular flakes and cores. That, together with the diminished size of the tools and the selection of the more sharply fracturing cherty and jaspery material, would reflect a change in the environmental setting over the previous stage, which necessitated these rather delicate tools. The prolificity of awl-points would also bring into the picture some rudimentary utilitarian working on leather, bones, wood and such material.

Of the miscellaneous tools, mention may be made of one type, important by virtue of its infrequent occurrence in the hitherto-known Indian flake-blade assemblages. This is represented by two specimens (nos. 77 and 78: fig. 11; pl. XX B) of differing sizes but both made on cherty material, which have a flattish underside, keeled dorsal face and triangular cross-section. Both the side-edges bear steep secondary trimming, which, in no. 78, is characterized by profuse notching and delicate retouch by pressure-flaking; while one end is slightly rounded, the opposite tip is pointed. The suitability of such a tool as a pick or for retouching is evident from the shape. While the larger specimen (no. 77) may have been useful for the larger flakes and blades, the smaller one would seem to go well with the small-tool facies described above and would perhaps even have been hafted to bone or wood for effective use.

Thus, the post-Acheulian stage at Nagarjunakonda clearly saw the emergence of the flake-blade industries and, from the manner in which the entire central high ground is scattered with such tools, would bear testimony to their slow but methodical evolution here. On the basis of the technological data gleaned from the variety of tools of differing shapes, three trends would appear to have been available, although the exiguous stratigraphical data would clearly forbid any relative chronological analysis. The trends are (1) a Mousterian affinity in the flake tools, (2) blade-and-burin assemblage and (3) retouched and pressure-flaked scrapers.

The first group, i.e. tools with Mousterian affinity, is substantiated not only by a large number of flake-points with elaborate steep and inverse retouch (nos. 36, 37, 68 and 69: figs. 9 and 10; pl. XVIII) but also by the converging scarred triangular or biconical Mousterian core (no. 25: fig. 9; pl. XVI B). Presumably contemporary with this are the bifacial small tools on cores, simulating the handaxe, but in miniature, with stepped and often retouched edges (nos. 85 and 86: fig. 13; pl. XXI A). These would seem to have been the genetic successors of the handaxe but, as the changed environment would have warranted, could have been used as stabbing and throwing spear-points and not used by hand, and would themselves be the forerunners of the delicate almond-shaped points with elaborate retouch (nos. 80 and 81: fig. 11; pl. XX B), which may perhaps ultimately account for the similar but more diminutive points of the epi-palaeolithic microliths on chert and agate. In fact, but for the clear difference in raw material, the last two could well go under the microlithic *milieu.*

That these have occasionally an incipient tang (nos. 35, 36 and 76: figs. 9 and 10; pls. XVIII A and XX B) would seem to be further attested by a specimen (probably incomplete) of what is almost an asymmetric single-shouldered arrow-head (no. 89:

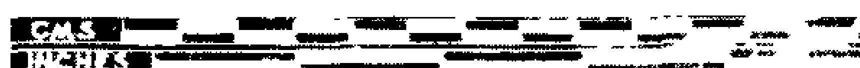
India may, it has been suggested, have been far from an independent entity but may have mainly evolved into multiple small-tool industries. The Nagarjunakonda industries particularly show, on the one hand, a persistent blade-burin element and, on the other, a further ramification into diminishing sizes of delicately-retouched scrapers and points as the evident forerunner of the true microlithic industry.



Nagarjunakonda: nullah-section at Locality C showing the lowest cemented gravels. *See page 76*

To face p. 60



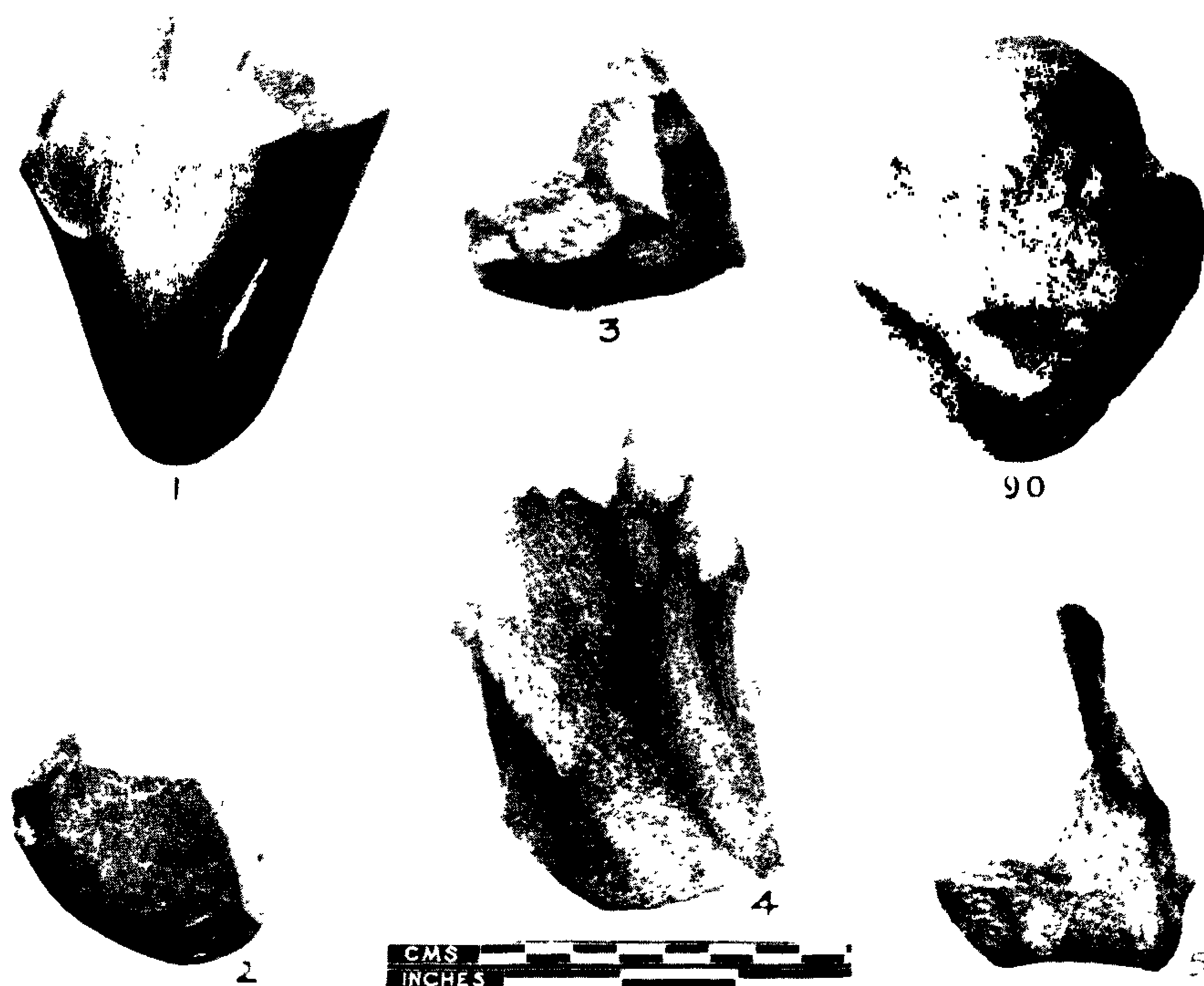


A. *Palaeolith from Nagarjunakonda: bifacial core tool. See page 65*

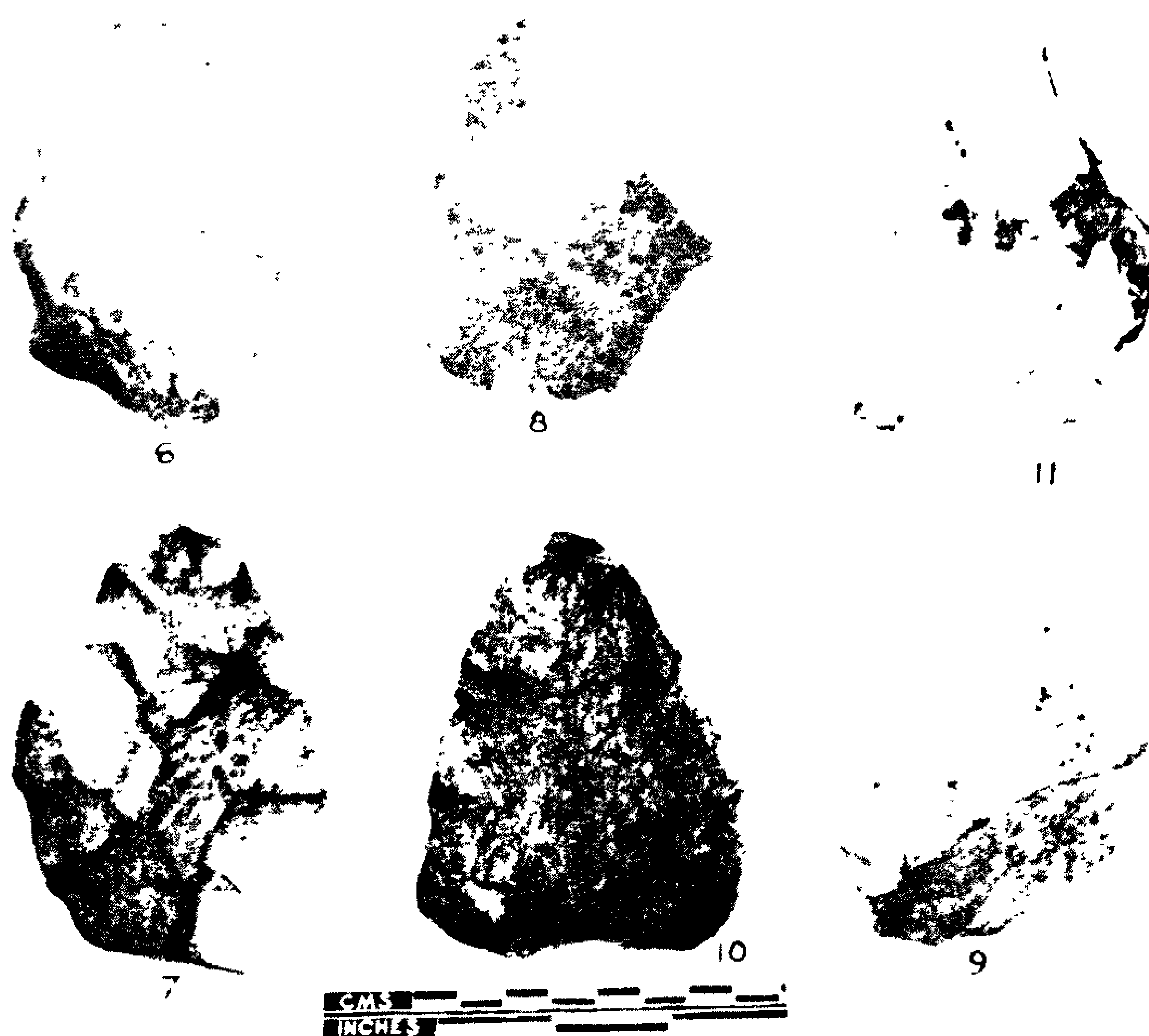




B. *Palaeolith from Nagarjunakonda: bifacial core tool. See page 65*



A. *Palaeoliths from Nagarjunakonda: pebble tools.* *See page 61*



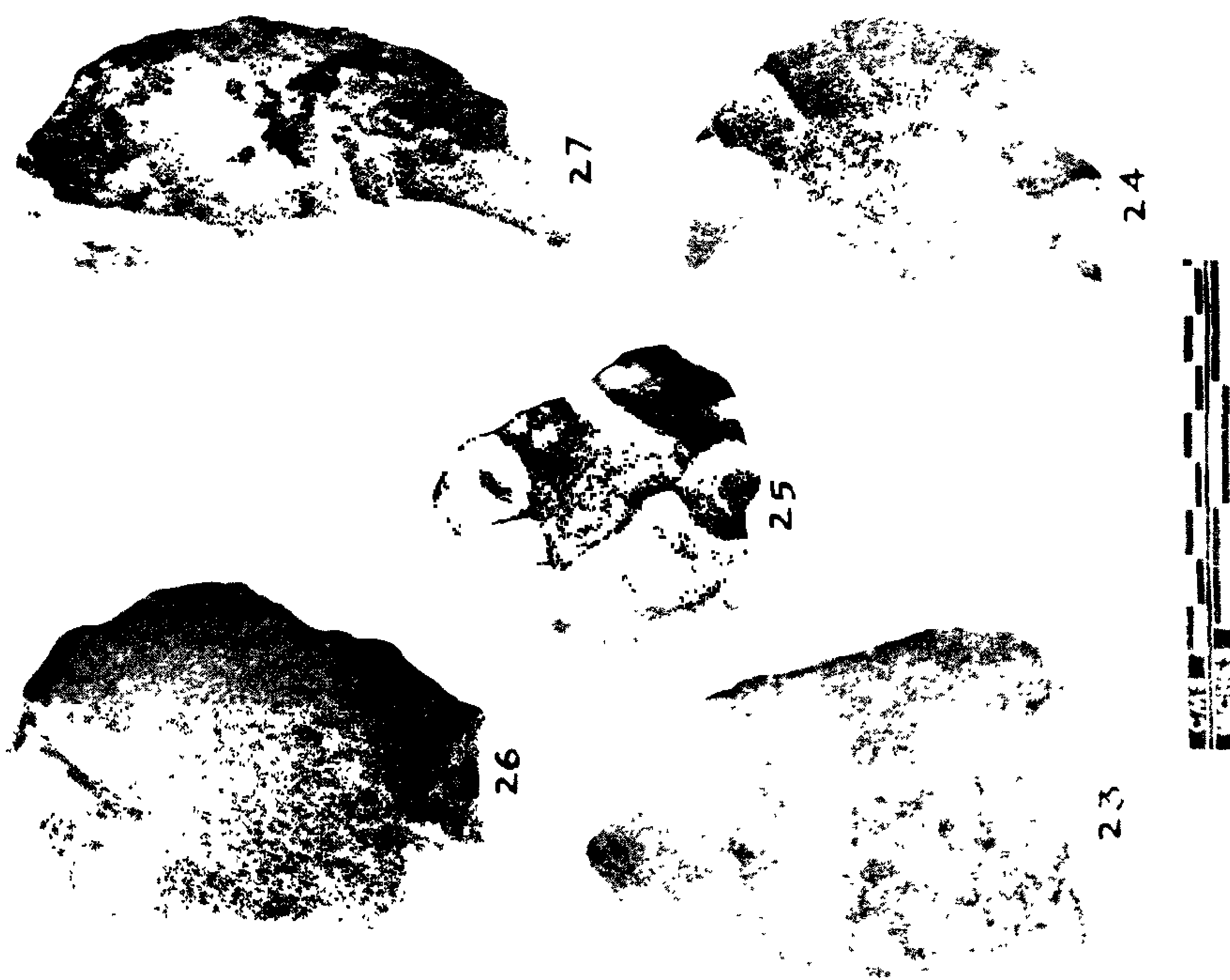
B. *Palaeoliths from Nagarjunakonda: 6-10, bifacial core tools; 11, handaxe on flake.* *See pages 63-67*

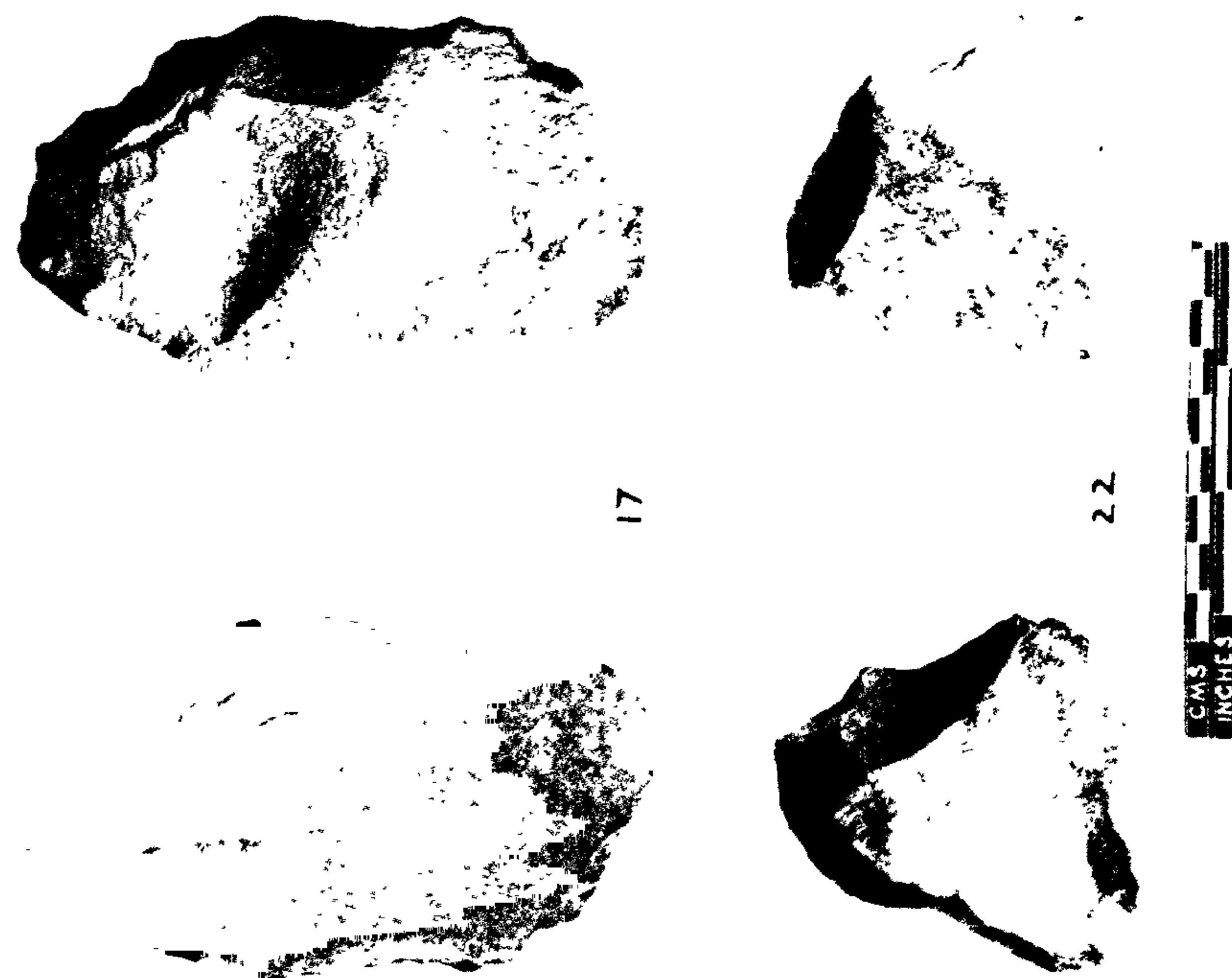


A. *Palaeoliths from Nagarjunakonda: 12, handaxe on flake; 13, cordiform handaxe; 14, ovate; 15, cleaver. See pages 65-68*

B. *Palaeoliths from Nagarjunakonda: cleavers. See page 68*

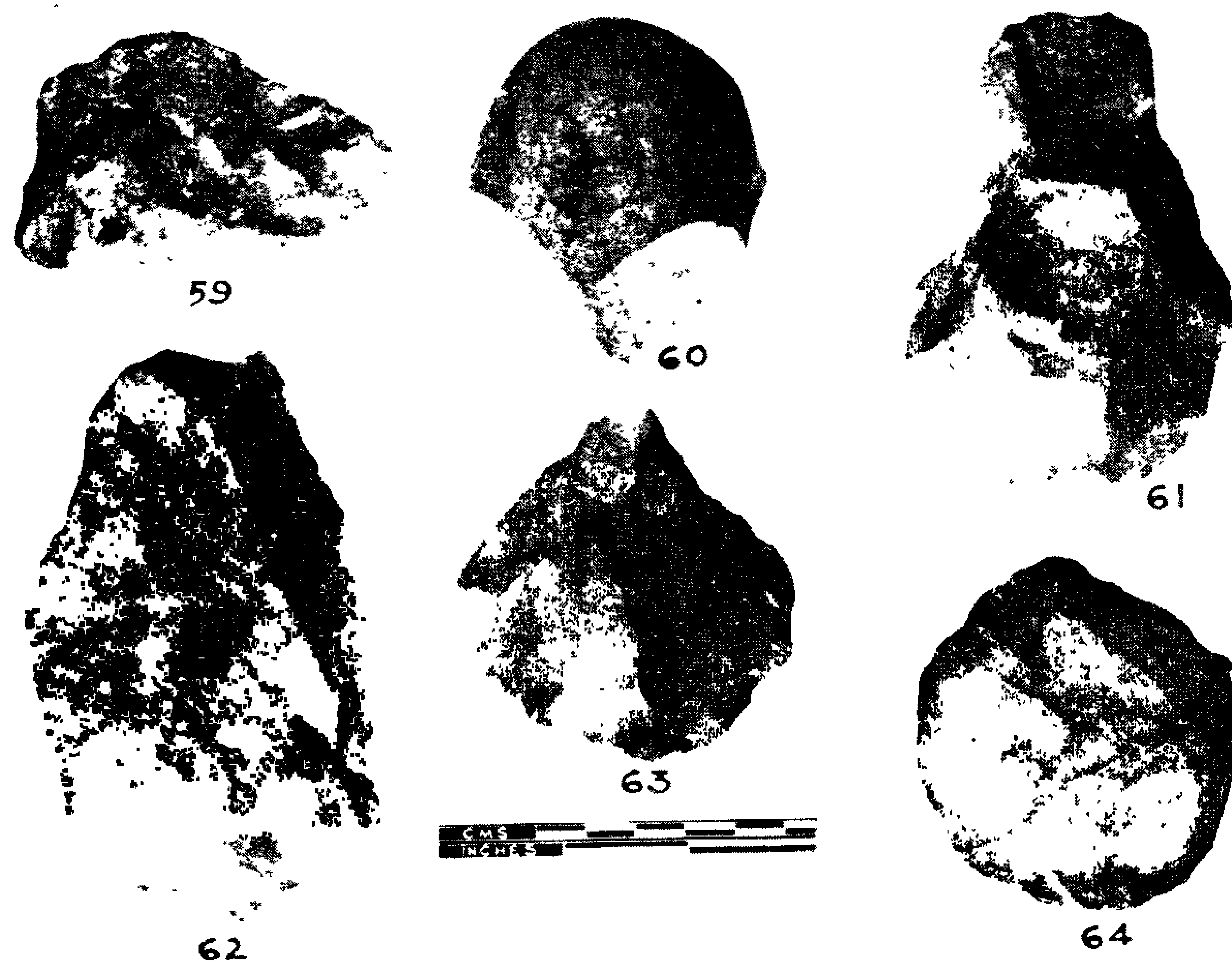
To face pl. XVI



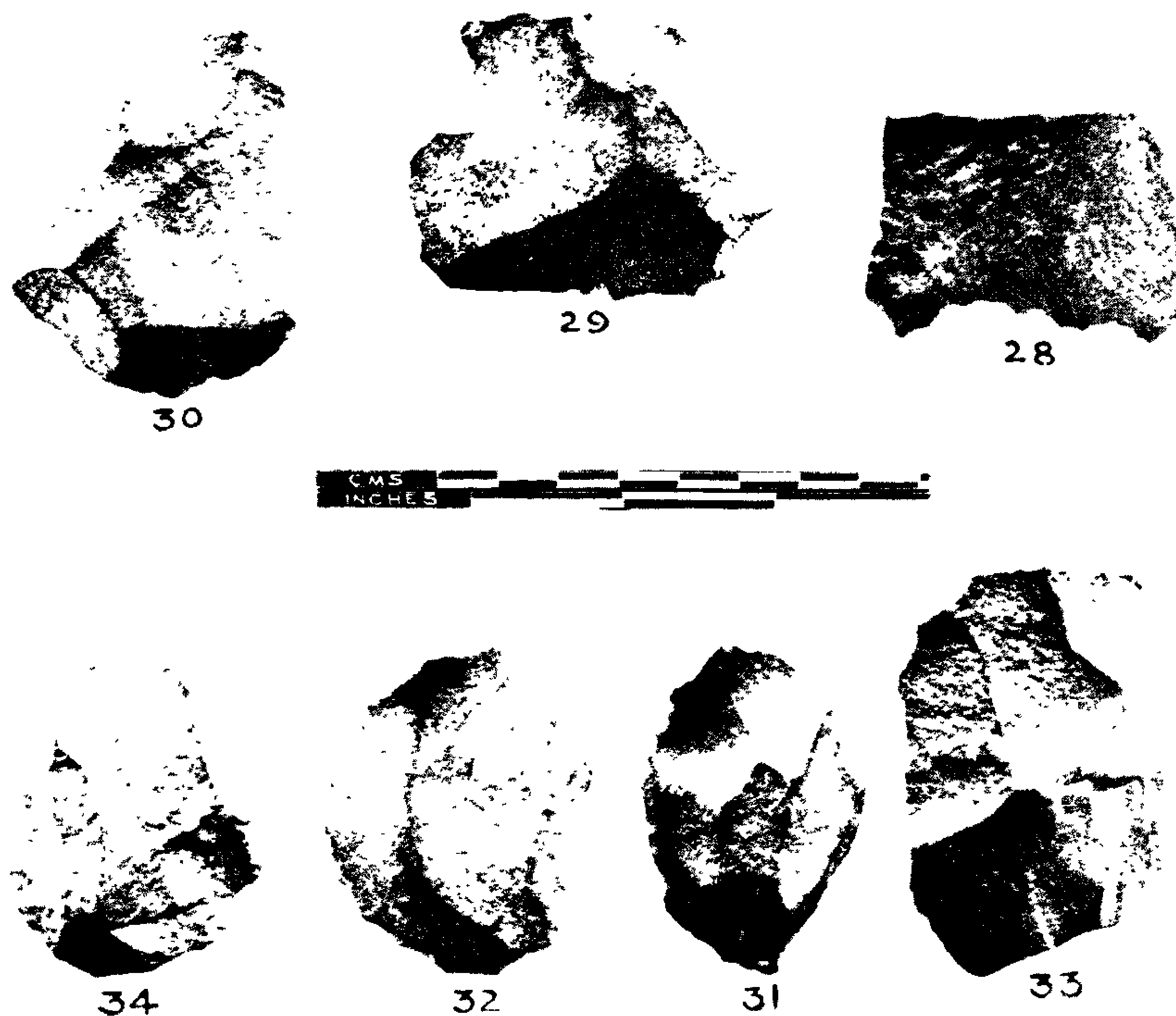


A. *Palaeoliths from Nagarjunakonda: cleavers. See page 68*

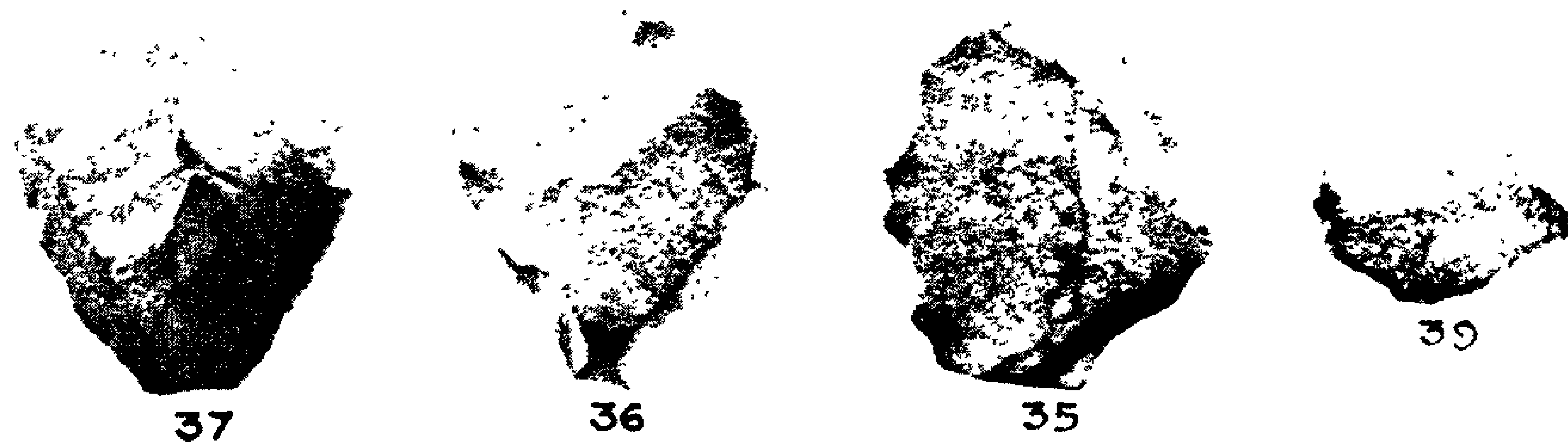
B. *Palaeoliths from Nagarjunakonda: plain-platform cores, core-scrapers and flakes. See page 69*



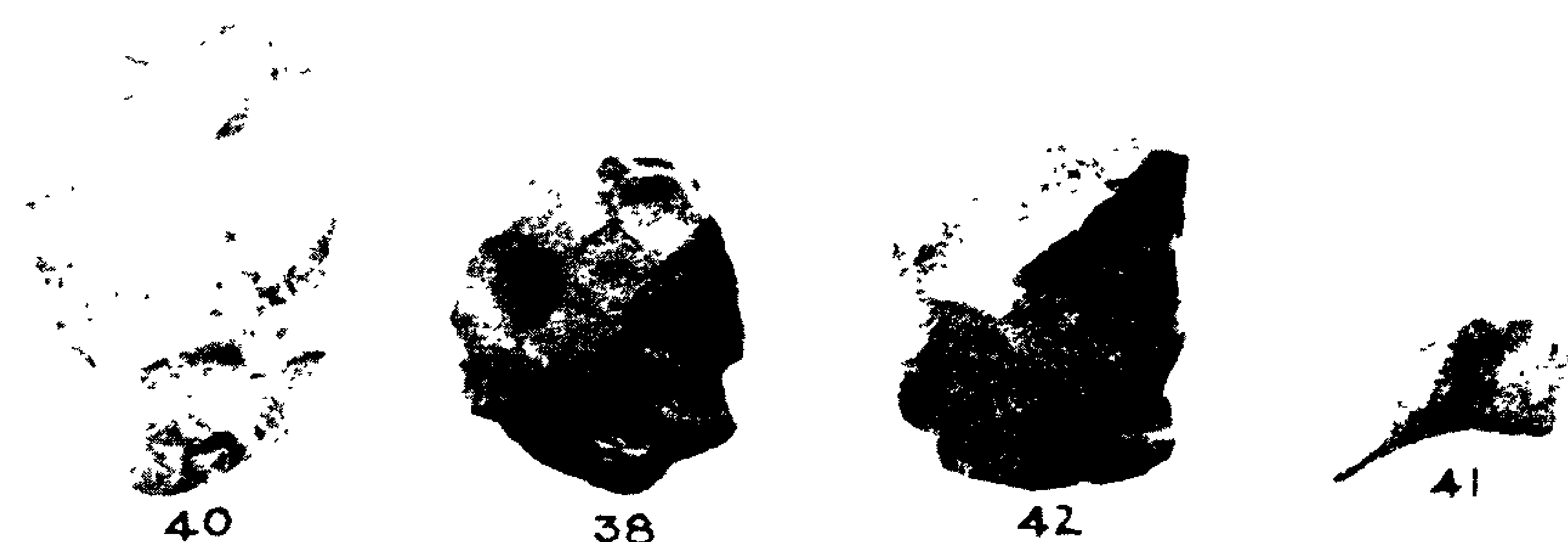
A. *Palaeoliths from Nagarjunakonda: 59 and 60, pebble tools; 61, bifacial core tool; 62, cleaver; 63 and 64, cordiform handaxes. See pages 63-65 and 69*



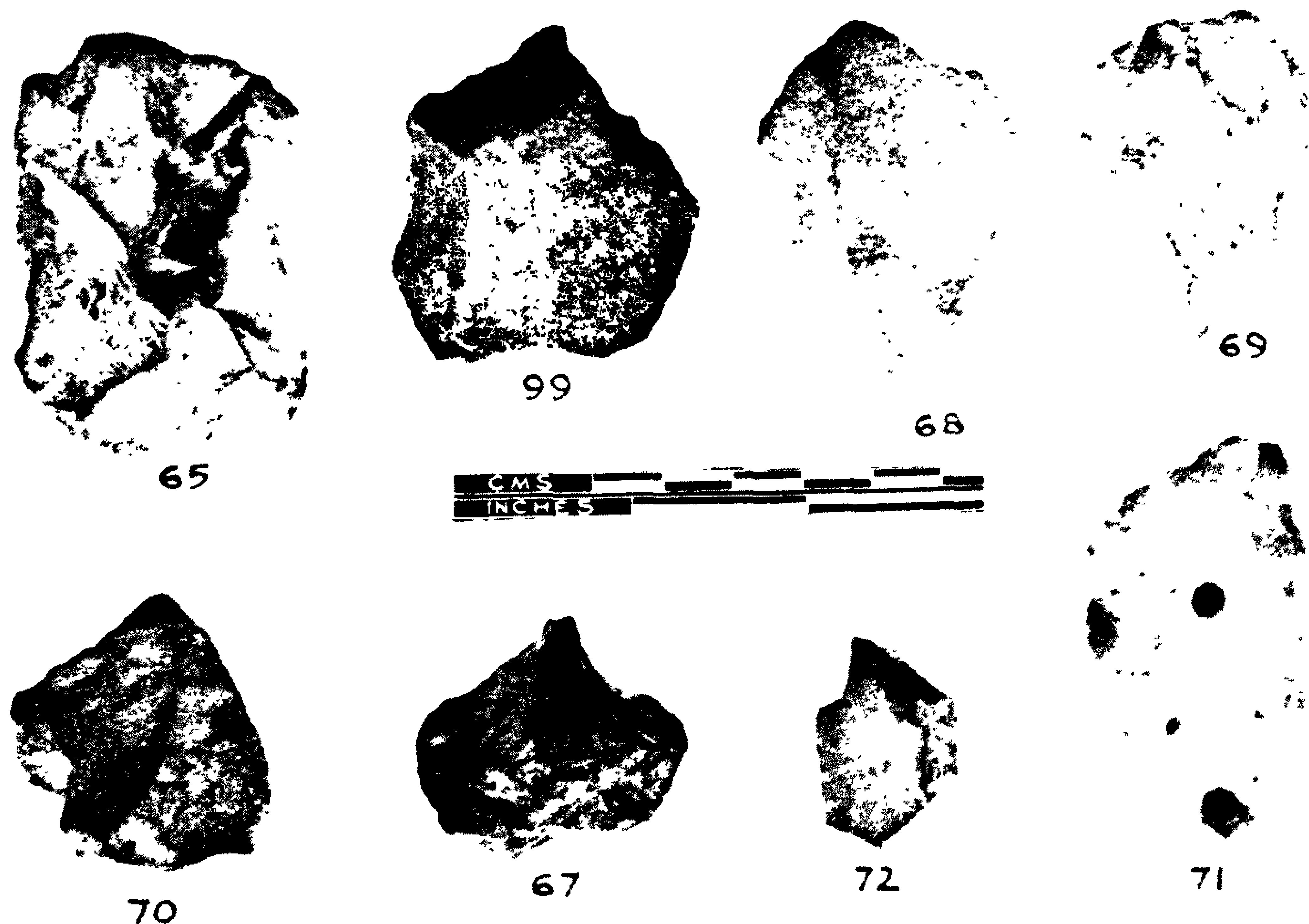
B. *Palaeoliths from Nagarjunakonda: 28, flake-scraper; 29-31, proto-levallois flakes; 32-34, prepared platform flakes. See pages 71 and 72*







A. *Palaeoliths from Nagarjunakonda: prepared platform flakes.* *See page 72*

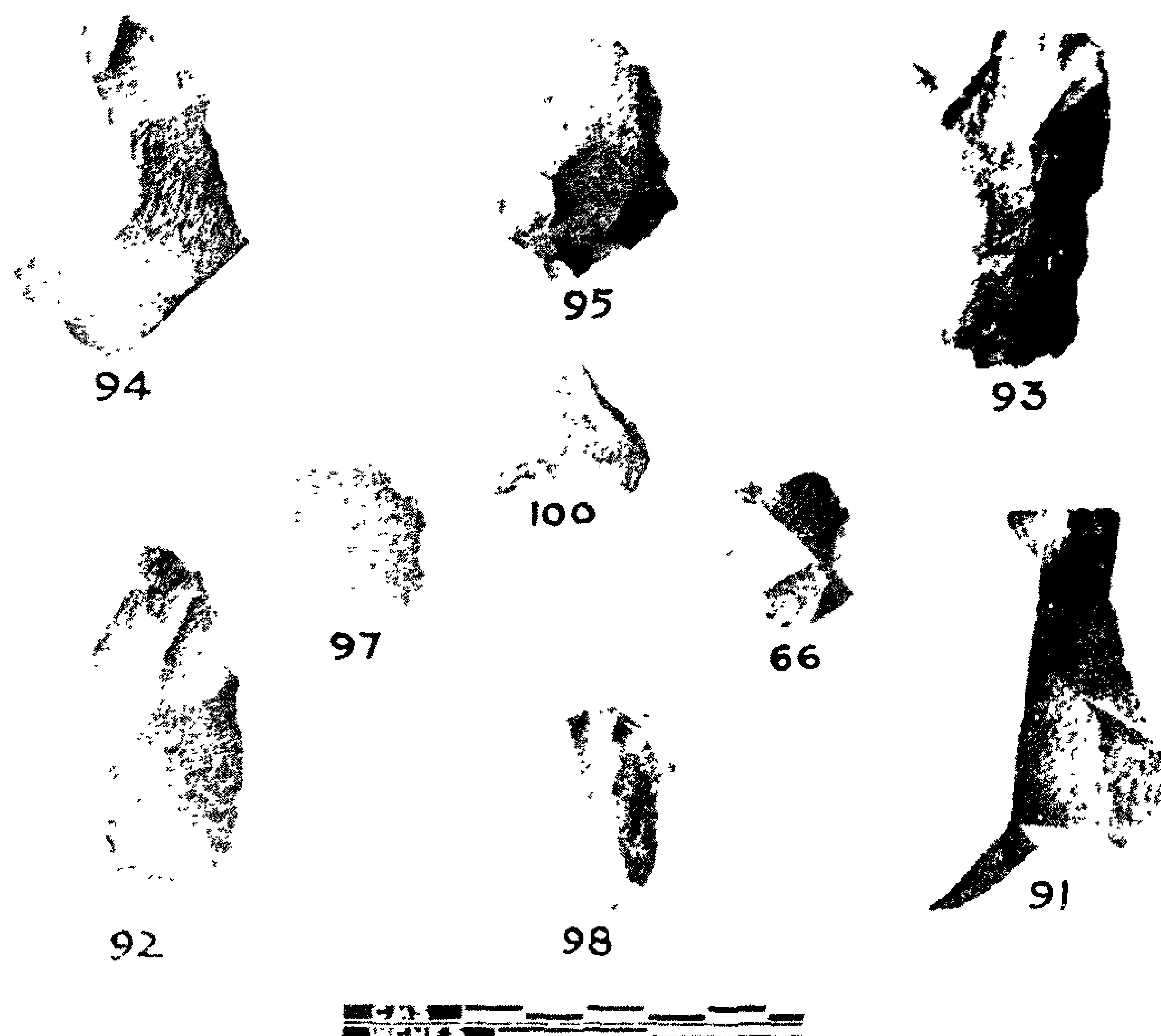


B. *Palaeoliths from Nagarjunakonda: 65 and 71, flake-blades, 67 and 99, axe-points, 68-70, triangular flakes with retouch, 72, burin.* *See pages 74-76*

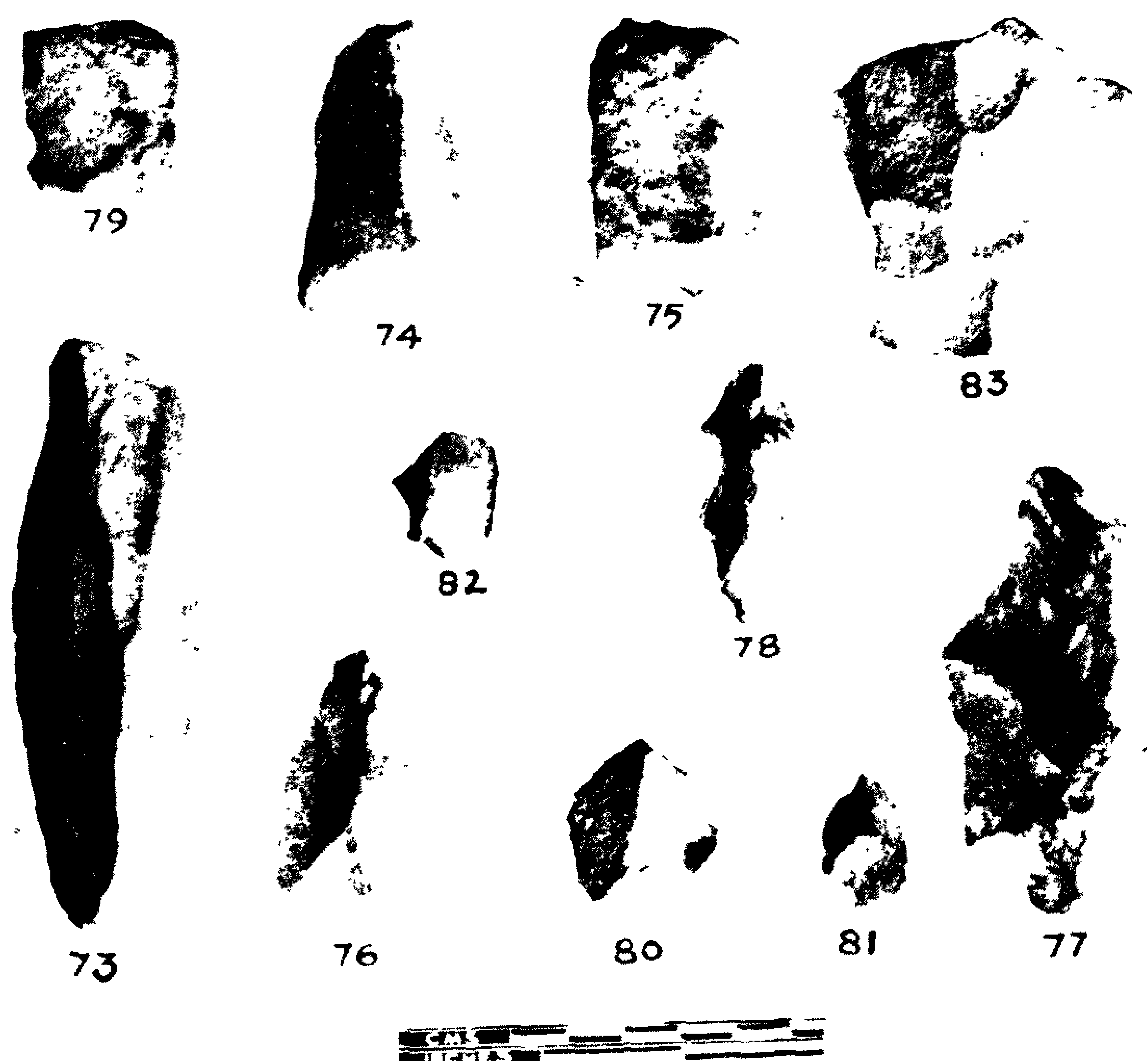


A. *Palaeoliths from Nagarjunakonda: flake-blades and blades. See pages 72-74*

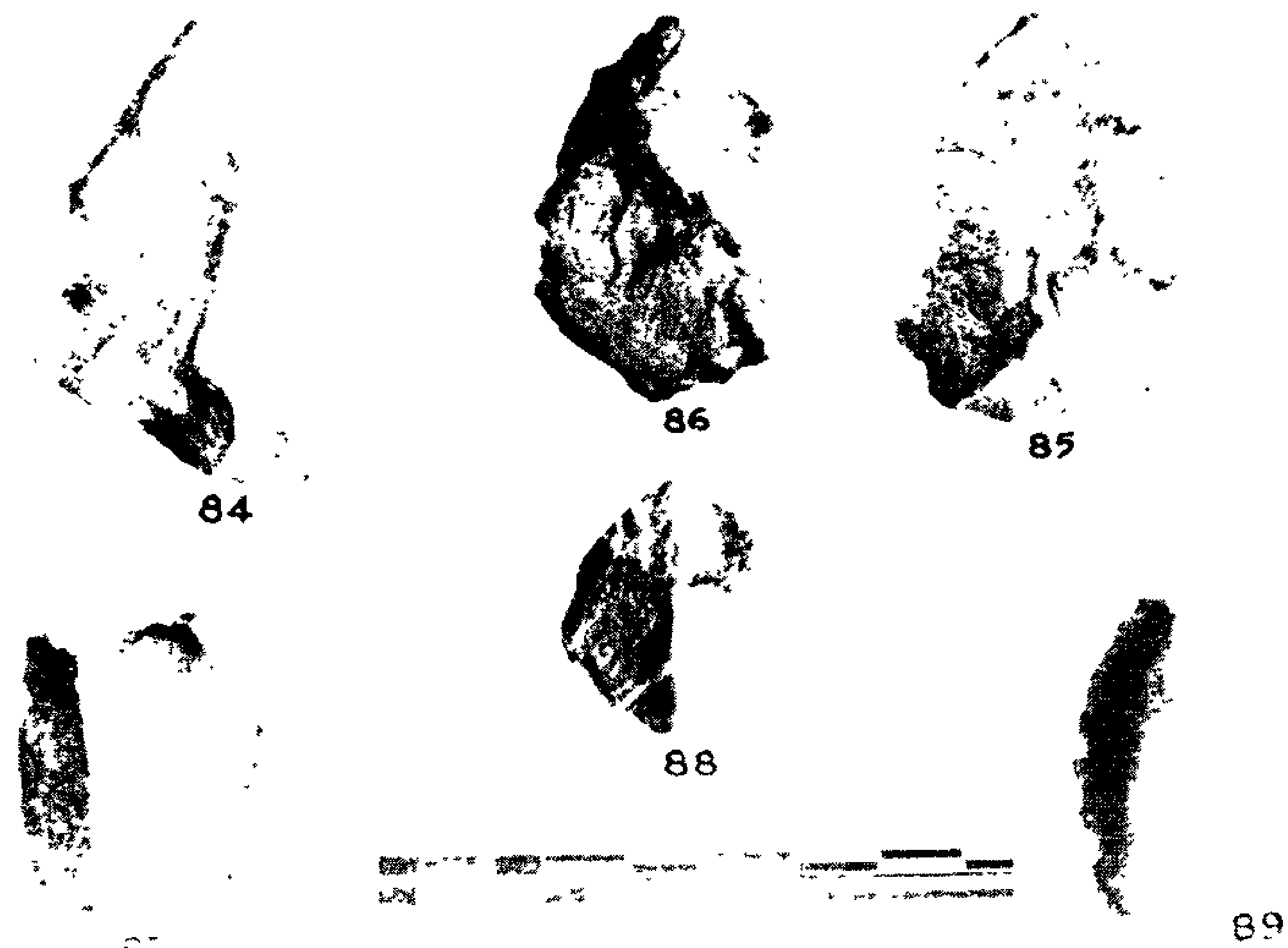
B. *Palaeoliths from Nagarjunakonda: burins. See pages 74-76*



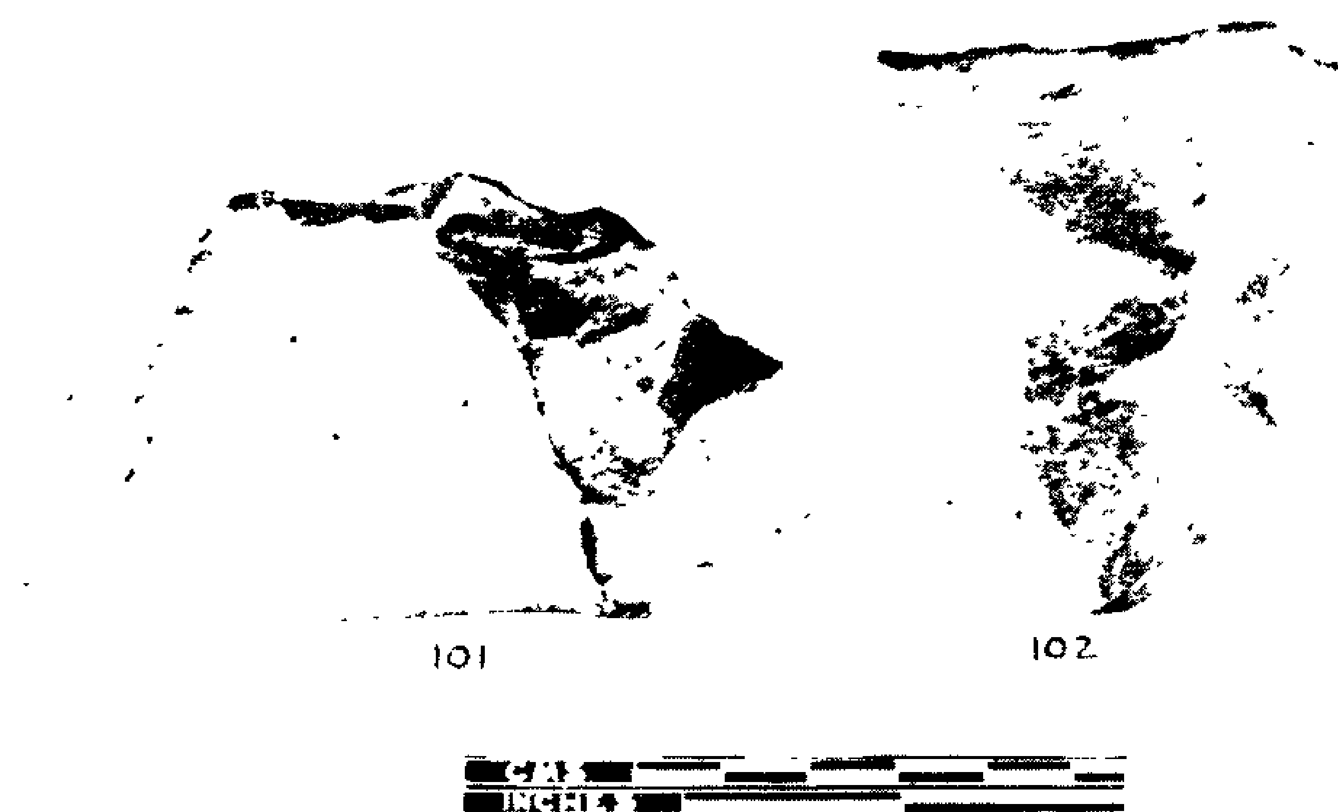
A. *Palaeoliths from Nagarjunakonda: 66, 91-93, 95, 97 and 100, medium-to-diminutive scrapers; 94, flake-blade; 98, awl-point. See page 74*



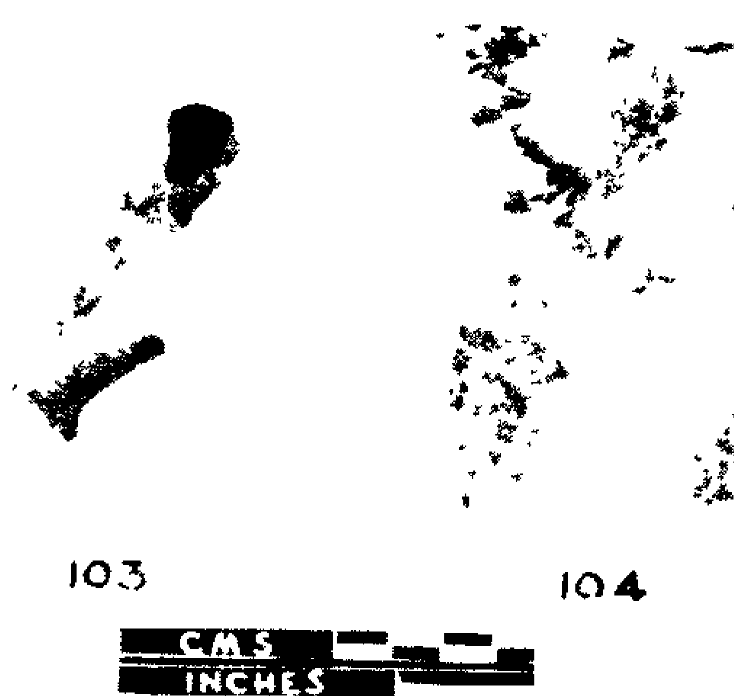
B. *Palaeoliths from Nagarjunakonda: 73, 75 and 79, flake-blade and blades; 74 and 80-82, medium-to-diminutive scrapers; 76, triangular flake with retouch; 77 and 78, retouchers; 83, fluted core. See pages 74 and 77*



A. *Palaeoliths from Nagarjunakonda: 84, triangular flake with retouch; 85 and 86, bifacial points; 87 and 88, medium-to-diminutive scrapers; 89, shouldered arrow-head. See pages 74-77*



B. *Palaeoliths from Nagarjunakonda: 101, 'tortoise'-core; 102, fluted core. See pages 72 and 77*



C. *Palaeoliths from Nagarjunakonda: burins. See page 77*

fig. 13; pl. XXI A), which has a prominent neatly-retouched flake-scar on the underside and partly cortical upper side and would recall the more elaborately-worked counterparts of the African Aterian.

The second group, i.e. blade-tools, has prolific shapes and differing sizes and thicknesses and in themselves show stages of perfection. The burins not merely show some variety but also manifest their technique on some cores and flakes, where the burin-type of retouch was employed for producing delicate scraper-edges. The persistent occurrence of slender blades with retouch in staggering numbers on the central high ground can only imply how the flake-tradition had specialized itself here.

The third group, viz. scrapers, follows their precursors of the Middle Palaeolithic but add to them variety and profuseness, by featuring on differing kinds of cores, flakes and blades, on the bulbar end or opposite ends, 'racloirs', 'grattoirs' and spoke-shaves with perforator- or awl-tips, and without them. Many of them have minutely and neatly pressure-flaked edges and worked body, which not only indicates the careful preparation of the core before they were detached but also the probable use of some retouching tools (nos. 77 and 78: fig. 11; pl. XX B) for nibbling the edges so delicately.

All these would cumulatively go to strengthen the differentiation and branching of the blade-flake *milieu* in the Upper Palaeolithic, culminating in the Microlithic, as also the manifest environmental transformation authenticated by their shape, size and technique, even in the lack of adequate direct ecological data.

D. The tools

The subjoined list gives a classified description of the palaeolithic tool-types.

(i) *Pebble tools*

No. 1. Primary flaking.—Flat sub-angular block with a series of alternate flake-scars removed transversely across producing a zigzag chopping edge. Probably incomplete.

Secondary flaking.—Practically none, except a few shallow flake-scars along the edge.

Type.—Lower Palaeolithic bifacial pebble chopper.

Fig. 5; pl. XIV A.

No. 2. Primary flaking.—Tabular round pebble, along a part of the edge of which have been chipped three or four flakes from a single direction, resulting in a steep-sided working edge not unlike an adze-edge, which was largely the result of the shape of the pebble.

Secondary flaking.—Little or none but for very small scaly scars along the working edge, perhaps due to use.

Type.—Lower Palaeolithic unifacial pebble chopper.

Fig. 5; pl. XIV A.

No. 3. Primary flaking.—Bifacially-trimmed pebble tool on an ovoid pebble with one side extensively chipped and the other side having only two scars along the two side-margins, thus lending a splayed and sharp, though limited, convex cutting edge, part of one side of which retains the pebble-cortex.

Secondary flaking.—Little or none.

Type.—Lower Palaeolithic pebble chopping tool. The cutting edge is not unlike a bifacial cleaver-edge. Is it a precursor on pebble of the cleaver of bifacial tradition?

Fig. 5; pl. XIV A.

No. 4. Primary flaking.—Tool like a rostrocarinate on a squattish pebble with a very elaborate unifacially-chipped steep scar on the V-shaped periphery, steep sharp keel and pointed end. The lower side is partly of the cortex and the rest of shallow primary scars. The hump is high and flat, and the butt-end is also vertically flaked, perhaps broken off.

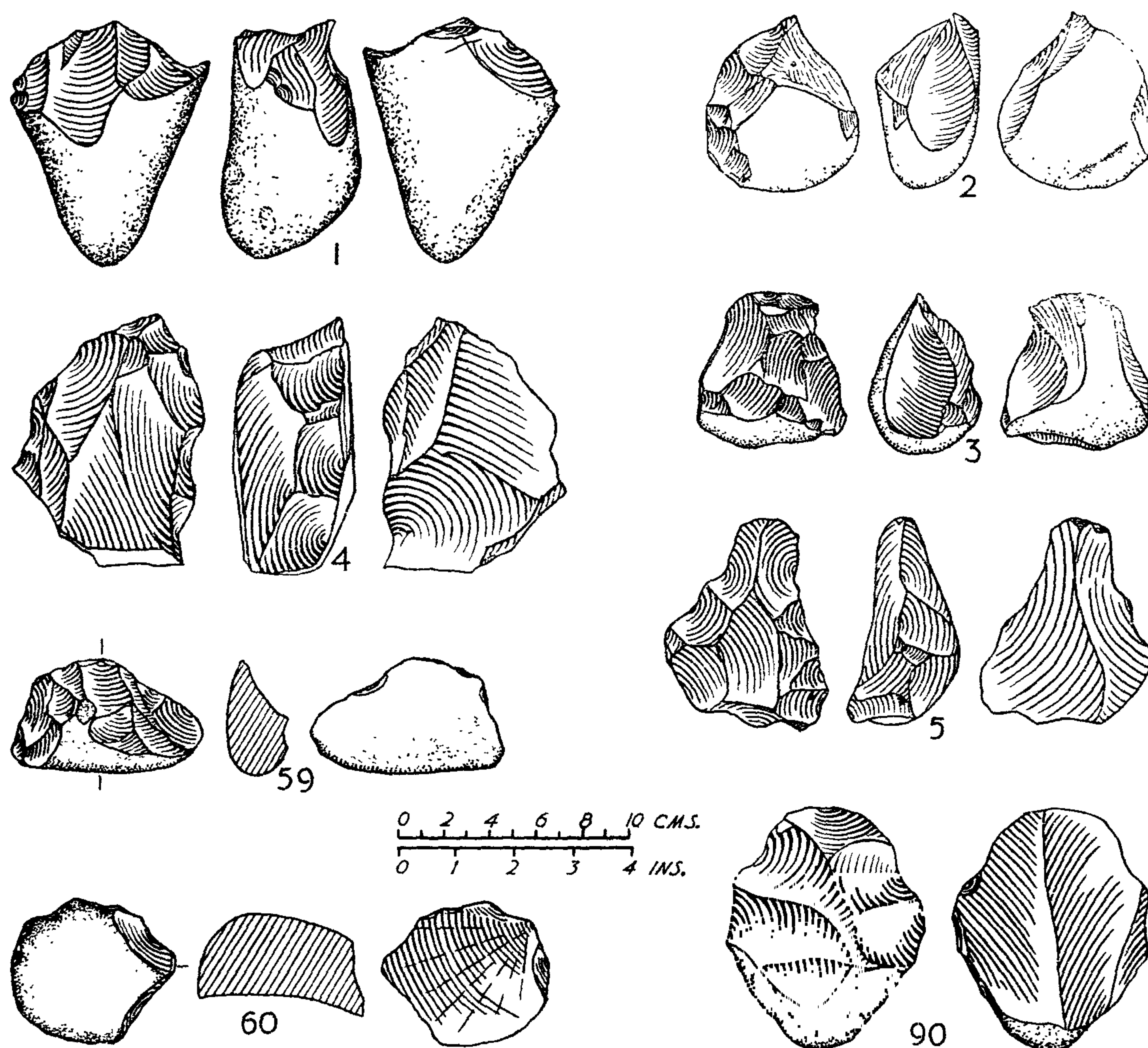


FIG. 5. *Palaeoliths from Nagarjunakonda: pebble tools*

Secondary flaking.—None.

Type.—Lower Palaeolithic rostroid picking tool anticipating the handaxe.

Fig. 5; pl. XIV A.

No. 5. Primary flaking.—Transitional from the pebble tool to the handaxe. Made on an elongated pebble extensively chipped on the dorsal side to form steep peripheral all-around scars with a cortical patched hump and keeled but tongue-like tip. The ventral side is made of two large scars of dissimilar size by sideward blows. Reminiscent of the rostrocarinate on the upper side and Victoria West on the lower side.[1]

Secondary flaking.—Practically none.

Type.—Bifacial handaxe of the early phase of the Lower Palaeolithic, corresponding to the Lower Abbevillean of Europe or Stellenbosch I of south Africa.

Fig. 5; pl. XIV A.

[1] It may be mentioned here that Victoria West types are available at the Kurnool sites.

No. 59. Primary and secondary flakings.—Unifacial tool on a flattish oval pebble with flakes removed from end to end, leaving on the base of the upper and on the whole of the lower side the original cortex.

Type.—Lower Palaeolithic unifacial chopper.

Fig. 5; pl. XVII A.

No. 60. Primary and secondary flakings.—Unifacial tool on a split pebble, with the underside forming a shallow negative scar and one half of the upper side steeply flaked to provide a nose-like end.

Type.—Lower Palaeolithic chopper on split pebble.

Fig. 5; pl. XVII A.

No. 90. Primary and secondary flakings.—Fan-shaped bifacial chopper but not alternately flaked. Its underside has a thin mid-rib and two major lateral scars and the upper side a series of scars fringing the scalloped edge, thus leaving very little of the cortex on the lower butt-end.

Type.—Lower Palaeolithic bifacial pebble scraper.

Fig. 5; pl. XIV A.

(ii) *Bifacial core tools*

No. 6. Primary flaking.—Handaxe, slightly rolled, on an ovoid pebble, with a peripheral jagged edge due to alternate flaking, ridged and keeled dorsal and ventral sides, a blunt pointed tip and a generally bulged oval cross-section.

Secondary flaking.—Minor small flake-scars and serrations perhaps due to utilization.

Type.—Lower Palaeolithic crude handaxe.

Fig. 6; pl. XIV B.

No. 7. Primary flaking.—Handaxe on an ovoid pebble with extensive bifacial chipping to get a more or less straight continuous peripheral edge and rounded tip, though still with the median hump on both the sides, but with a less bulging oval cross-section than no. 6.

Secondary flaking.—Limited stepped flaking.

Type.—Early Acheulian handaxe.

Fig. 6; pl. XIV B.

No. 8. Primary flaking.—Pear-shaped handaxe of a less-than-medium size with scalloped edges, perhaps due to incomplete flaking, a sharp butt-edge and a rounded tongue-shaped tip.

Secondary flaking.—Limited stepped flaking; cross-section rather flattish lenticular, due to the unfinished nature of the tool.

Type.—Early Acheulian handaxe. Picked up from the third gravel-layer in the nullah-section.

Fig. 6; pl. XIV B.

No. 9. Primary flaking.—Ovoid handaxe with bifacial chipping, producing a straight and sharp peripheral cutting edge all round.

Secondary flaking.—Extensive steep flaking apparent; edges chipped off due to use.

Type.—Advanced handaxe of the Middle Acheulian or Stellenbosch II stage.

Fig. 6; pl. XIV B.

No. 10. Primary flaking.—Regular triangular bifacial *coup-de-poing* with an extensive and careful chipping all round to provide a straight sharp cutting edge and with smooth dorsal and ventral sides. The butt-end is, however, heavier but very gradually thins out towards the pointed tip.

Secondary flaking.—Evolved bifacial handaxe of the Upper Acheulian or Stellenbosch III stage.

Fig. 6; pl. XIV B.

No. 61. Primary and secondary flakings.—Bifacial core tool, the upper half of which is shaped into a limited, spatulate cleaver-edge. Though typologically transitional between the handaxe

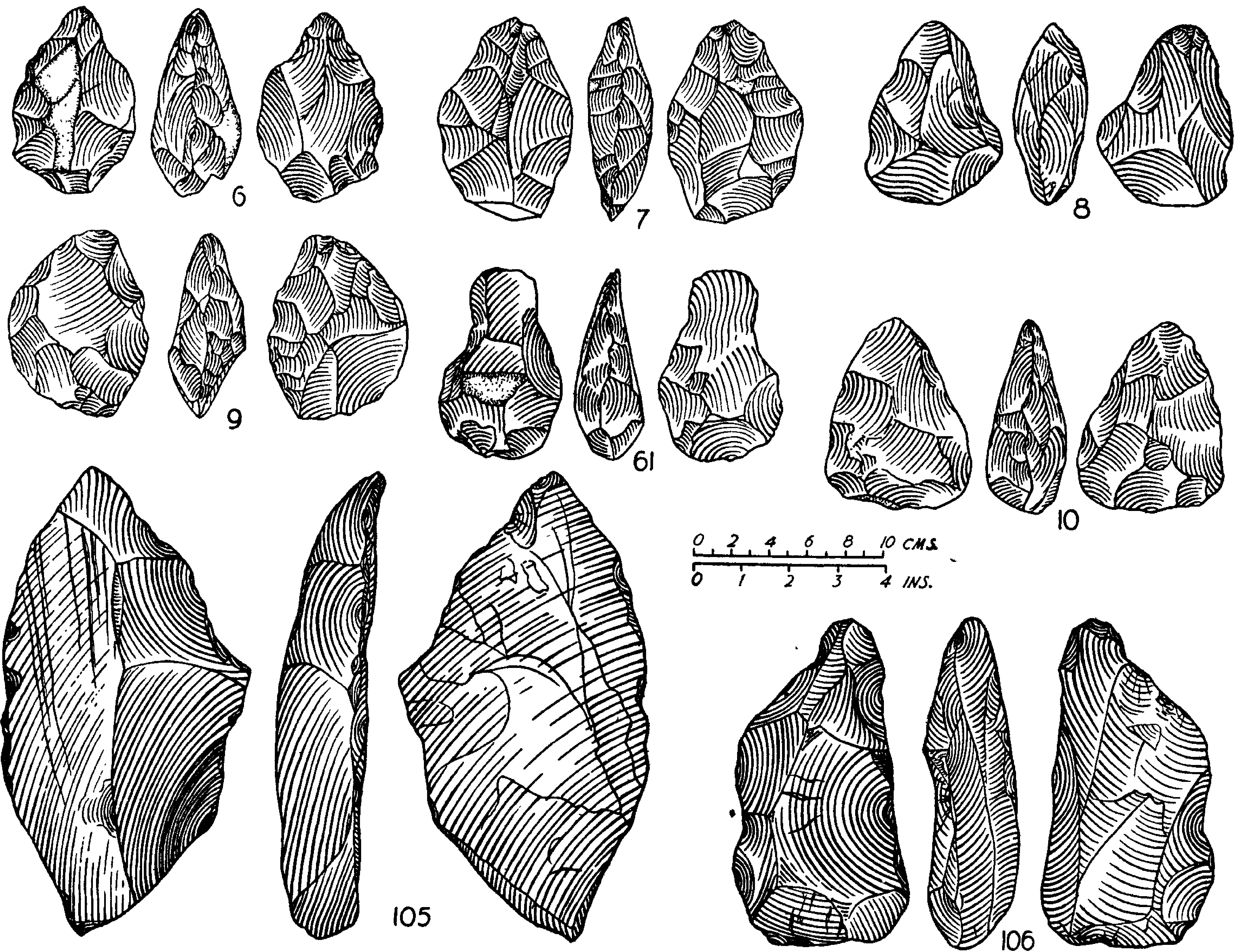


Fig. 6. *Palaeoliths from Nagarjunakonda: bifacial core tools*

and cleaver, its edges show considerable alternate and resolved flaking to provide a fairly straight edge.

Type.—Lower Palaeolithic bifacial cleaver.

Fig. 6; pl. XVII A.

No. 105. Primary and secondary flakings.—Large-sized free-flaked Abbevillean bifacial tool on metamorphosed quartzite with bold marginal scars and an extensively-chipped underside.

Type.—Lower Palaeolithic biface.

Fig. 6; pl. XIII A.

No. 106. Primary and secondary flaking.—Impressive specimen of the Victoria West type of bifacial tool, belonging typologically to the Early Acheulian by virtue of the implied preparation of the underside by the array of marginal scars which are truncated by the large major negative scar of their opposite margin and bestow a keel-like crooked tip-end. The upper side is extensively chipped.

Type.—Lower Palaeolithic handaxe of the Early Acheulian stage.

Fig. 6; pl. XIII B.

(iii) *Handaxes on flakes*

No. 11. Primary flaking.—Handaxe made on a large flake with the dorsal side extensively chipped to form a sharp cutting edge all round, the ventral side mainly of the large single flake-scar and with a pointed tip, humped butt and limited striking platform, with a few marginal scars lending the tool a lenticular section.

Secondary flaking.—Extensive tiny flake-scars and stepped flaking on the dorsal side along the edges.

Type.—Flake handaxe of the Middle-Upper Acheulian stage, with essentially a bifacial technique on a plain platform-flake.

Fig. 7; pl. XIV B.

No. 12. Primary flaking.—Evolved Acheulian handaxe on a large flake of quartzitic sandstone having a perfect flaked body, slightly-humped central part, pointed tip and smooth large primary flake-scar on the ventral surface.

Secondary flaking.—Elaborate stepped flaking giving the tool a plano-convex cross-section. The bulbar scar on the ventral side is also smoothly trimmed off to merge with the flat flake-scar surface of the underside.

Type.—Advanced Acheulian flake handaxe of the Stellenbosch IV stage.

Fig. 7; pl. XV A.

(iv) *Cordiform handaxes*

No. 13. Primary flaking.—Small and neat heart-shaped handaxe on core with the dorsal side formed of a series of centrally-directed flakes and the ventral side flaked flatter but with an unchipped cortical patch on one side—apparently due to the unfinished condition of the tool.

Secondary flaking.—Careful and elaborate stepped flaking, resulting in a sharp straight edge all around the tool, excepting where it is unfinished.

Type.—Cordate handaxe of the typical advanced Acheulian stage, analogous to the European Early Mousterian bifaces.

Fig. 7; pl. XV A.

Nos. 63 and 64. More or less similar to no. 13, being, besides, finished tools. No. 64 particularly has a very thin lenticular section and even a slight S-twist and is as much an ovate as a cordate handaxe type.

Fig. 7; pl. XVII A.

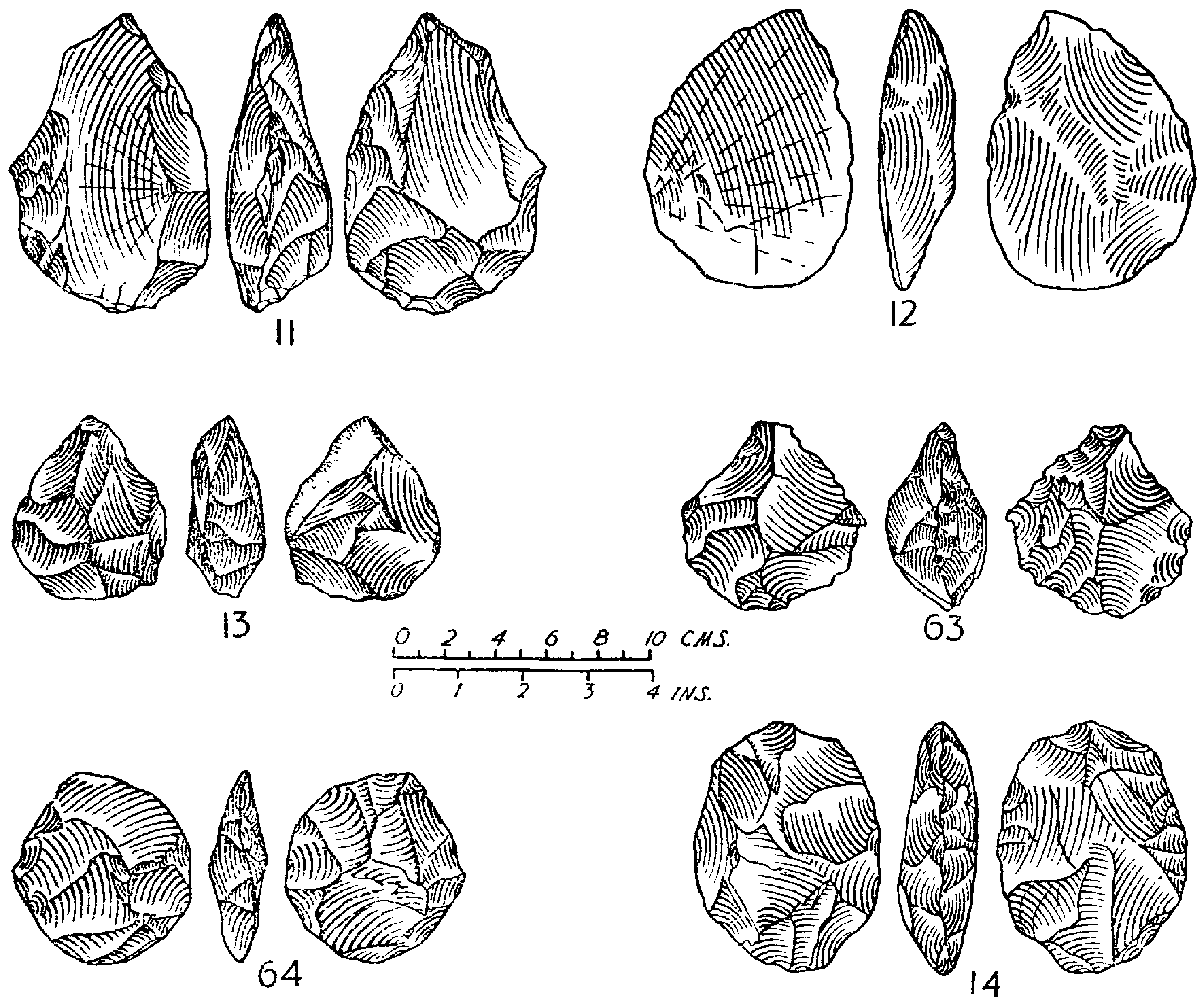


FIG. 7. *Palaeoliths from Nagarjunakonda: 11 and 12, handaxes on flakes; 13, 63 and 64, cordiform handaxes; 14, ovate*

(v) *Ovate*

No. 14. Primary flaking.—Symmetrical but rolled bifacial ovate, extensively chipped on both sides to produce a smooth and flat lenticular cross-section.

Secondary flaking.—Elaborate resolved and stepped flaking.

Type.—Bifacial ovate of the Upper Acheulian or Stellenbosch IV stage.

Fig. 7; pl. XV A.

(vi) *Cleavers*

No. 15. Primary flaking.—A finished tool of the bifacial tradition, with an extensively flaked dorsal side, exhibiting stepped flaking, straight and sharp edges and convex section. The ventral side has a trimmed right margin; a side-knock administered on its upper zone had detached a large flake and resulted in a smooth flake-scar all over the ventral side and a sharp curved cutting edge at the lower end. This resulted in lower edge being transversely curved and not straight and in imparting a general ovate shape to the tool.

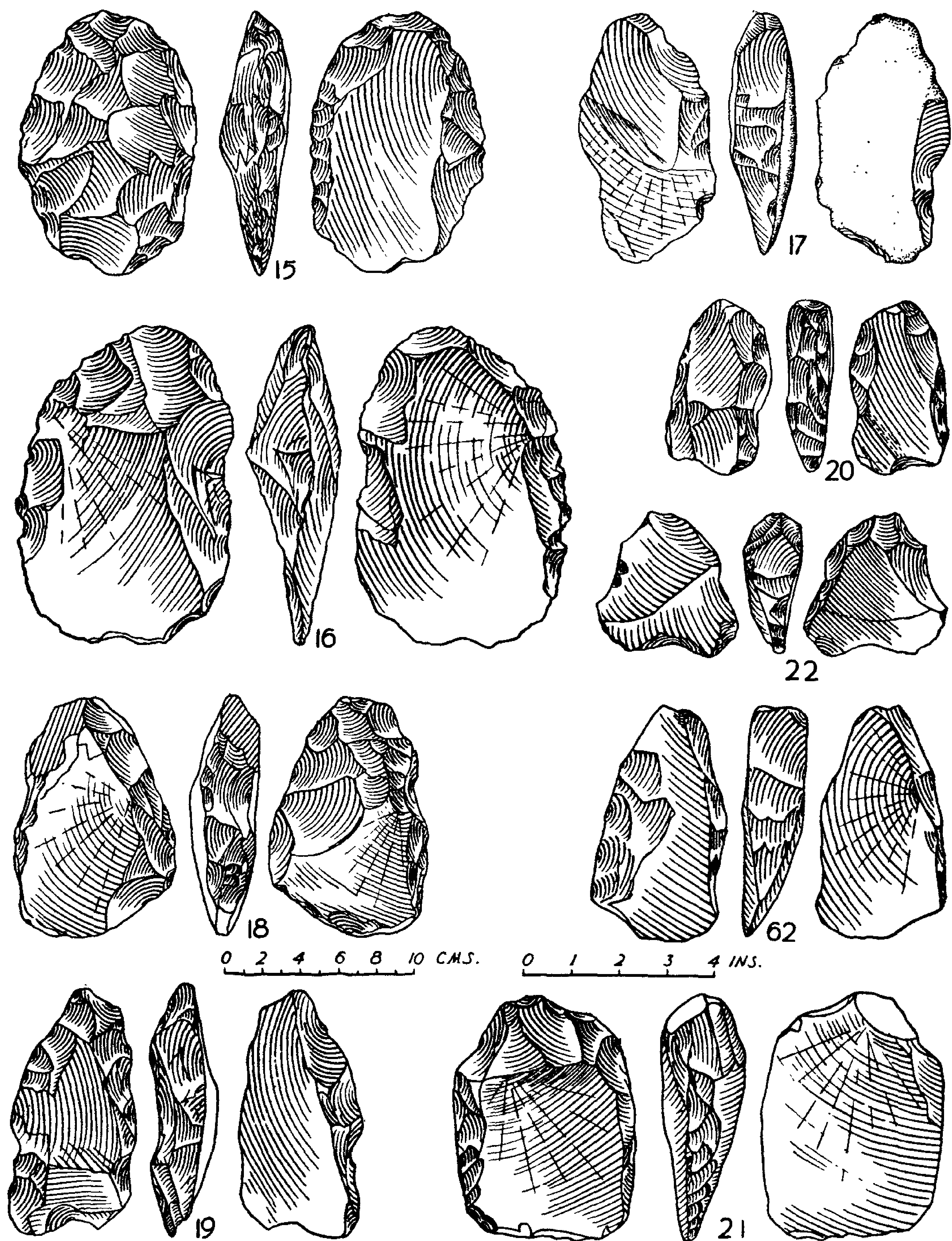


FIG. 8. *Palaeoliths from Nagarjunakonda: cleavers*

Secondary flaking.—Marginal trimming with thin scars on the left ventral edge, giving a slightly biconvex section to the tool. Edges serrated due to use.

Type.—Cleaver of bifacial tradition of the Lower-Middle Acheulian or Stellenbosch II stage.

Fig. 8; pl. XV A.

No. 16. Primary flaking.—Cleaver of Vaal technique on a large pebble with the alternate marginal faceted preparation and subsequent sideward blows from their upper part across the body of the tool, resulting in a wide cleaver-edge at the bottom and a parallelogrammatic cross-section across its body. On the dorsal side a hump has been caused by horseshoe-trimming on the upper butt-edges also, and a large flake-scar is found only across the lower two-thirds of the tool, whereas the ventral side is entirely made of the negative flake-scar.

Secondary flaking.—Bulb of percussion on the ventral side trimmed off by secondary flaking; minor trimming on its left edge as well. The lower working edge is worn due to use.

Type.—Cleaver of Middle Acheulian or Stellenbosch III stage.

Fig. 8; pl. XV B.

No. 17. Primary flaking.—An unfinished cleaver of the Vaal technique with one side marginally trimmed and flake detached from it, while on the other side the marginal trimming had been commenced, the rest of the side being of pebble-cortex. By the way in which the tool is trimmed and its lower edge rendered oblique, it may have had the 'guillotine'-type cutting edge. It graphically shows how such cleavers were fabiicated and would point to their local manufacture.

Secondary flaking.—Nil.

Type.—Vaal-type cleaver of the Middle Acheulian or Stellenbosch III stage.

Fig. 8; pl. XVI A.

No. 18. Primary flaking.—Finished but worn-out cleaver of shale of typical Vaal technique with the 'guillotine'-type oblique cutting edge and parallelogrammatic cross-section of the body.

Secondary flaking.—Marginal retouch, to straighten the edges, and stepped flaking to balance the tool.

Type.—Cleaver of the Middle-Upper Acheulian or Stellenbosch III stage.

Fig. 8; pl. XV B.

No. 19. Primary flaking.—Finished cleaver of double-Vaal technique, with marginal trimming continued up to the butt-end, making it pointed and making the tool itself a narrow isosceles triangle in outline, and with parallelogrammatic cross-section at any point.

Secondary flaking.—Marginal trimming showing stepped flaking; the lower cutting edge notched due to utilization.

Type.—Cleaver of the Middle Acheulian or Stellenbosch III stage.

Fig. 8; pl. XV B.

No. 20. Primary flaking.—Miniature double-Vaal cleaver, rather rolled, almost similar to the previous one in every respect but for the rather truncated butt-end.

Secondary flaking.—Working edge notched due to use.

Type.—Cleaver of Middle-Upper Acheulian or Stellenbosch III stage or probably later, with the post-Stellenbosch V-Fauresmith affinities.

Fig. 8; pl. XV B.

No. 21. Primary flaking.—Cleaver employing Vaal technique made on quartzite almost metamorphosed into sandstone with a horseshoe-trimming on the upper dorsal side and negative flake-scar on the entire ventral side. The cross-section, however, is a trapezium instead of parallelogram and would thus offer a parallel to the cleaver-type of stage IV of the Vaal river-basin gravel-succession in south Africa, worked by van Riet Lowe, and to the Late Acheulian of east Africa.

Secondary flaking.—Marginal, end-struck minor trimming, giving the flake a neat symmetric look and balance on both sides, together with a straight cutting edge, worn due to use.

Type.—Cleaver of the Upper Acheulian or Stellenbosch IV stage.

Fig. 8; pl. XV B.

No. 22. Primary flaking.—Small horseshoe cleaver-shaped tool, rather imperfect, employing single-Vaal technique on one side and having a trapezoid cross-section across the body.

Secondary flaking.—The lower edge significantly notched in the middle and the notch carefully retouched with minute scales to serve as a hollow scraper or 'spoke-shave'; the remaining parts of the edge also retouched. The condition of the tool is fairly fresh but for the notched scraper-edge.

Type.—Horseshoe cleaver turned into a hollow scraper of the Upper Acheulian or Stellenbosch IV stage.[1]

Fig. 8; pl. XVI A.

No. 62. Text-book specimen of the cleaver of double-Vaal technique, with its side-margins trimmed, having sides with major flake-scars and a parallelogrammatic section.

Fig. 8; pl. XVII A.

(vii) *Plain-platform cores, core-scrapers and flakes*

No. 23. Primary flaking.—Made on a tabular block with a flat transverse medium hump sloping on either side to a blunt narrow top-edge and wide bottom-edge. The lower side is flat. The right dorsal side has a scalloped edge due to two large shallow primary scars, and the edge is serrated. The scalloped edge is either for facile grip or for being used as a chopping edge. The broad dorsal lower edge is steeply flaked unifacially to form an efficient scraper-edge. The tool anticipates the end-scrapers in the flake-tool complexes of the Middle Palaeolithic on the one hand and is like the adze-edged early pebble tools on the other.

Secondary flaking.—Little minor chippings along the scraper-edge.

Type.—Acheulian core-scraper.

Fig. 9; pl. XVI B.

No. 24. Primary flaking.—Clactonian discoid core with equatorial jagged edge due to the removal of alternate flakes; scars short and deep. Along one part of the ventral edge two deep flake-scars had been caused, perhaps to make the tool serve as a chopper-scraper.

Secondary flaking.—Part of the periphery step-flaked or retouched.

Type.—Clactonian core of biface tradition of the Lower Palaeolithic stage.

Fig. 9; pl. XVI B.

No. 25. Primary flaking.—Less-than-medium triangular flattish core, on the ventral side of which particularly are found centrally-directed triangular flake-scars along the margin. The edge all round is, however, sharp and indicates flakes having been removed by the plain-platform technique. The core is apparently of a type out of which Mousterian flakes could have been detached. The dorsal side-margin also shows neat converging flake-scars.

Secondary flaking.—None.

Type.—Mousterian core of the Middle Palaeolithic stage.

Fig. 9; pl. XVI B.

No. 26. Primary flaking.—Medium-to-large 'plain-platform' flake of oval shape with an asymmetric ridge on the dorsal side; the narrow left margin steeply flaked. Calcareous grit is sticking to the tool in patches.

Secondary flaking.—The striking platform and the dorsal left and lower edges trimmed so that the tool could serve as a side-scraper. Stepped flaking also apparent along the edges.

Type.—Early Acheulian scraper on a plain-platform flake. The tool was recovered from the cemented gravels in Locality C.

Fig. 9; pl. XVI B.

No. 27. Primary flaking.—Medium leaf-shaped flake on plain platform with a crooked lower pointed end, the sloping left dorsal margin of which is of pebble-cortex and the right margin has been chipped smoothly to get a straight sharp edge. The ventral side is of the primary flake-scar entirely. *Kankar*-patches are sticking to the tool.

[1] Cf. K. V. Soundara Rajan, 'Stone Age industries near Giddalur, Kurnool District,' *Ancient India*, no. 8 (1952), tool no. 14, p. 78, fig. 4, pl. XVIII.

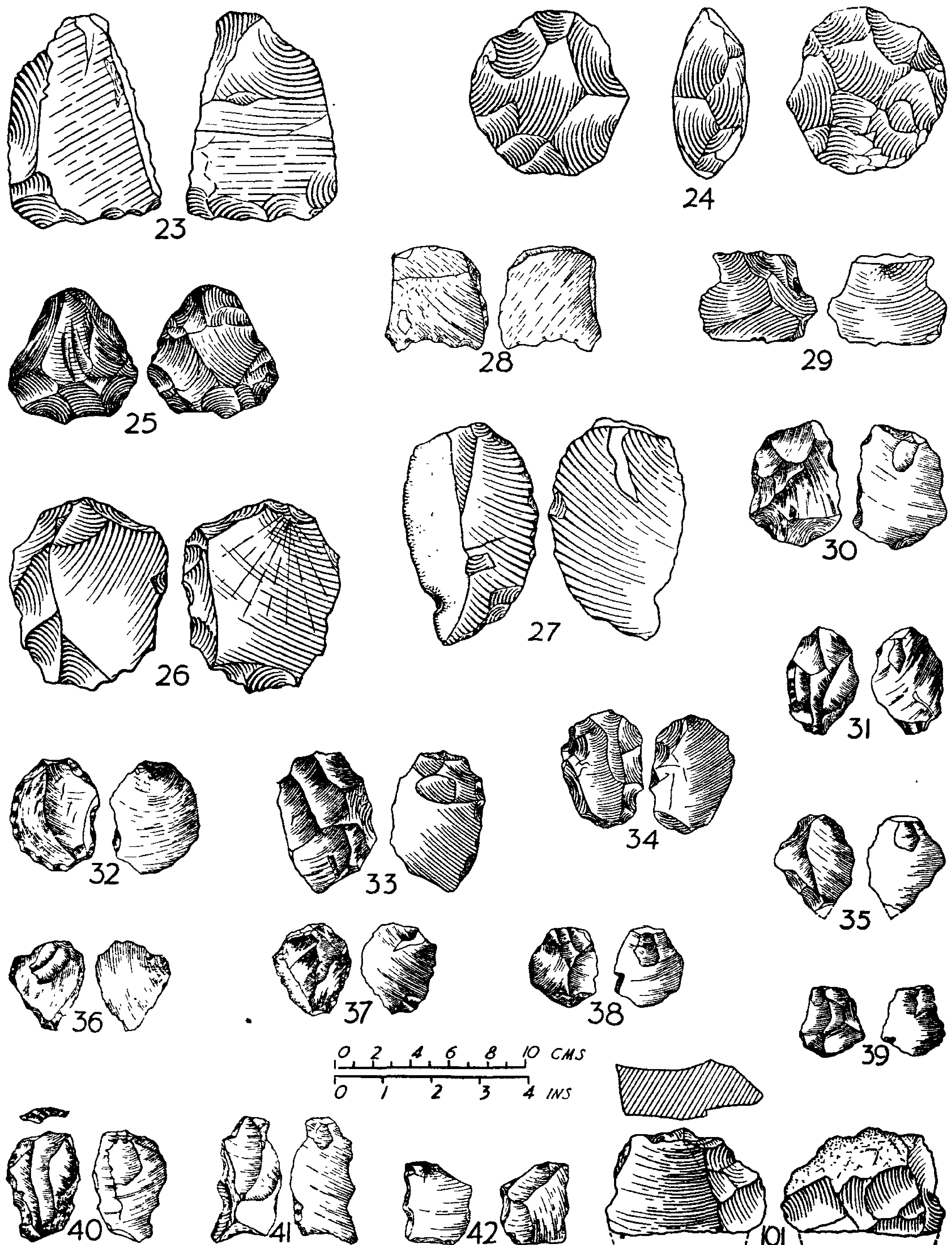


FIG. 9. *Palaeoliths from Nagarjunakonda: 23-28, plain-platform cores, core-scrapers and flakes; 29-31, proto-Levallois flakes; 32-42, prepared-platform flakes; 101, prepared-platform 'tortoise'-core*

Secondary flaking.—The bulb of percussion on the ventral side knocked by secondary flaking; stepped flaking also apparent on the dorsal side.

Type.—Asymmetrical cutting tool of the Early Acheulian stage on a plain-platform flake. The tool was recovered from the cemented gravel in Locality C.

Fig. 9; pl. XVI B.

No. 28. Primary flaking.—Small trapezoid flake with the left dorsal margin of sloping narrow cortical patch and the right side formed of an oblique flake-scar, the ventral side being the negative scar, with the point of impact also having been knocked off.

Secondary flaking.—The dorsal top-edge and right edge retouched to function as scraper-edges; the side-edge particularly exhibiting many notched scars, indicating the heavy use of the edge for scraping.

Type.—Flake-scraper of the Middle Acheulian stage.

Fig. 9; pl. XVII B.

(viii) *Proto-Levallois flakes*

No. 29. Primary and secondary flakings.—Less-than-medium plain and obtuse-platform flake with the height shorter than the width and with the dorsal side comprising a few shallow marginal scars. The ventral side is made of a diffused bulb and plunging flake-scar. The side-edges on either side of the platform are recessed, and the right dorsal upper edge particularly is retouched for producing this effect. Both the dorsal and ventral right bottom-edges carry nibbled scaly scars for use as scraper-edge.

Type.—Proto-Levallois flake-scraper of the Middle Acheulian stage.

Fig. 9; pl. XVII B.

No. 30. Primary and secondary flakings.—Less-than-medium flake with a very narrow restricted plain platform and a series of marginal scars along the ridged left dorsal edge and a few broader flake-scars along the right edge. The ventral side consists entirely of the bulbar scar. A limited minute retouch on the left ventral margin makes the tool a side-scraper.

Type.—Proto-Levallois flake-scraper of the Middle Acheulian stage.

Fig. 9; pl. XVII B.

No. 31. Primary and secondary flakings.—Small flake with a series of centrally-directed marginal flake-scars on the dorsal side and an obtuse striking platform. The ventral side reveals a mis-hit, and the badly curled-up flake-scar has resulted in a crude thick lower end. The right dorsal lower edge shows minute nibbling for a scraper-edge.

Type.—Proto-Levallois scraper of the Middle Acheulian stage.

Fig. 9; pl. XVII B.

(ix) *Prepared-platform flakes and 'tortoise'-core*

No. 32. Primary and secondary flakings.—Less-than-medium oval flake with an asymmetrical low ridge on the dorsal side and a diffused bulb and concave flake-scar on the ventral. The platform is faceted as in the Levallois industry. Minute nibbled retouch all along the periphery up to the platform has resulted in a nice scraper-edge for the flake.

Type.—Levallois flake-scraper of the Middle-Upper Acheulian stage.

Fig. 9; pl. XVII B.

No. 33. Primary and secondary flakings.—Less-than-medium prepared-platform flake with shallow marginal scars and with the ventral side showing bulb with coarse *eraillure* and rippled flake-scar. The dorsal right edge and ventral left edge are neatly retouched.

Type.—Levallois flake-scraper of the Middle Acheulian stage.

Fig. 9; pl. XVII B.

No. 34. Primary and secondary flakings.—Neat tongue-shaped small flake with narrow marginal flaking all around on dorsal side and with the ventral side made of the flake-scar. The bulb has been knocked off by secondary flaking and its left margin is also flaked for a scraper-edge.

Type.—Levallois flake of Middle-Upper Acheulian stage.

Fig. 9; pl. XVII B.

Nos. 35 to 37. Primary and secondary flakings.—Three specimens with the shape of broad arrow-head, made on small flakes by Levallois technique by side-blow and showing elaborate marginal secondary retouching. One of them, no. 35, has an incipient tang also, retouched edges and a leaf-shape and is not unlike a Mousterian flake with its plain platform.

Type.—Late Acheulian flake-points.

Fig. 9; pl. XVIII A.

No. 38. Primary and secondary flakings.—Small thin-sectioned broad leaf-shaped flake tool, with plain platform at 90°, with a low dorsal ridge and with the lower edge very carefully nibbled into a 'nosed' end-scraper—not unlike that of the Aurignacian or Mousterian end-scrapers.

Type.—Late Acheulian end-scraper.

Fig. 9; pl. XVIII A.

No. 39. Primary and secondary flakings.—Very small thin flake in Levallois technique with the dorsal bottom-edge delicately and steeply nibbled into an end-scraper edge and the dorsal right margin made into an awl-like point by retouching the edges.

Type.—Late Acheulian end-scraper-*cum*-awl.

Fig. 9; pl. XVIII A.

Nos. 40 and 41. Primary and secondary flakings.—Two specimens of less-than-medium flakes of Levallois technique, the first, no. 40, on banded grey cherty quartzite and the second, no. 41, on fine-grained grey quartzite, both with the side-margins and lower ends very carefully retouched—often by pressure-technique—and heavily notched due to use as side-scrapers and hollow scrapers. In no. 41, the left dorsal end is worked from either side into a beak-like point, which makes the tool a combined scraper and perforator. It may be recalled in passing that in the Aurignacian levels of France, in the Perigordian stage, exactly similar tools are available. In the present collection there are half a dozen specimens of this type.

Type.—Middle-Upper Palaeolithic scraper-*cum*-perforator.

Fig. 9; pl. XVIII A.

No. 42. Primary and secondary flakings.—Small flake-blade with the left dorsal edge carefully retouched into a scraper-edge with a pointed end near the platform. The ventral left edge is also trimmed. The bottom-edge had snapped, so that we do not know its nature. The platform is steeply nibbled up to the left corner, which is made blunt-pointed like the right one.

Type.—Flake-blade perhaps of the Middle-Upper Palaeolithic stage.

Fig. 9; pl. XVIII A.

No. 101. 'Tortoise'-core of the prepared-platform technique, with marginal centrally-directed scars and a large negative scar, resulting from the flake having been detached from the core by a knock on its top, and with a faceted platform. The lower half is missing.

Fig. 9; pl. XXI B.

(x) *Flake-blades and blades*

Nos. 43 to 48. Primary and secondary flakings.—Nos. 43 to 46 are elongated blades with lengthy flake-scars on the body and stepping below the platform, which indicate that they were not flaked by the hammer-technique but by the punch-technique. The edges of nos. 45 and 46 show retouch; in no. 46, the end is snapped. While nos. 45, 46 and 47 have a general triangular cross-section, no. 43 has a flat trapezoidal section. Nos. 43 and 46 have prepared platforms and no. 44 a dished plain platform; in no. 45, the platform has been trimmed off by secondary flaking. No. 47 is a leaf-shaped arrow-head on a slender longish blade. No. 48 is a diminutive specimen of a backed blade on patchy-red jasper with steep retouch on the left margin and careful secondary retouch by pressure-flaking on the platform, right margin and bottom, to serve as scraper-edges.

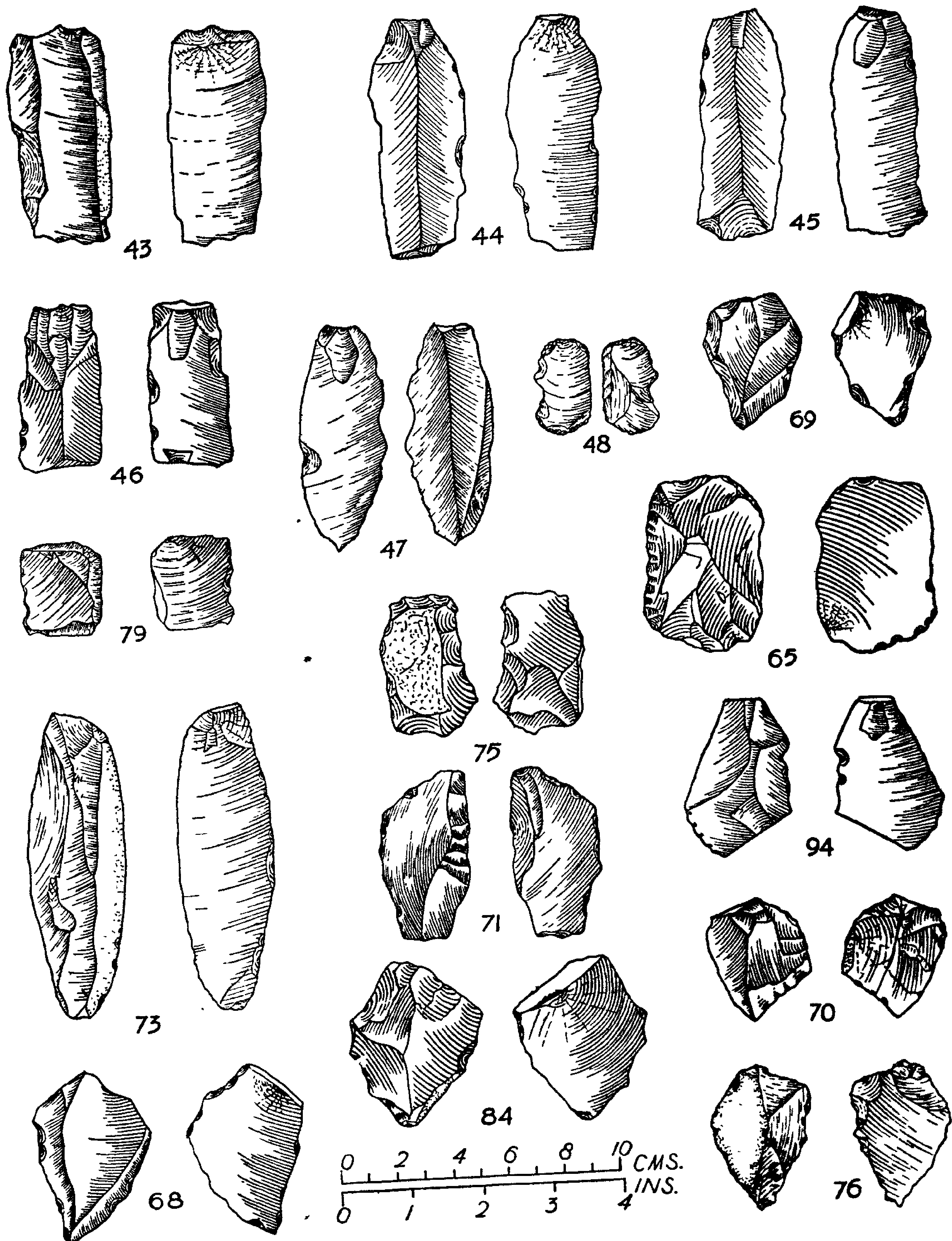


FIG. 10. *Palaeoliths from Nagarjunakonda: 43-48, 65, 71, 73, 75, 79 and 94, flake-blades and blades; 68-70, 76 and 84, triangular flakes with retouch*

Type.—Upper Palaeolithic or Mesolithic blades.
Fig. 10; pl. XIX A.

Besides the above, nos. 65, 71, 73, 75, 79 and 94 (fig. 10; pls. XVIII B and XX) belong to the flake-blade and blade category inasmuch as they have slender and semi-rectangular forms, often steeply retouched margins and intentional backing and ridging. The platforms, where they exist are either faceted or right-angled and plain, and the scars are of a diffused nature due to the punch. They pertain to the stage prior to the regular and stereotyped blades of the pressure-flaking technique. No. 71 is a delightful specimen of the group.

(xi) *Triangular flakes with retouch*

Nos. 68-70, 76 and 84 (fig. 10; pls. XVIII B, XX B and XXI A) belong to the Mousteroid or Moustero-Levlloisean category, wherein the fashioning of the flake into an effective thrusting point, with deliberate inverse retouch and faceted, battered or plain-platform end and pointed tip, is characteristic. One of them, no. 76, has an incipient tang.

(xii) *Awl-points*

Awl-points (fig. 11; pls. XVIII B and XX A) form a characteristic feature of both the Middle and Upper Palaeolithic tool-assemblages. Of the specimens, nos. 67, 98 and 99, the first two are essentially of the borer-type with the notched edge on either side of the nosed awl-point, while the last is a rather diminutive scraper-*cum*-borer specimen, with half the perimeter of the edges showing careful and delicate retouch. The tool goes with the diminutive scraper group.

(xiii) *Medium-to-diminutive scrapers*

Nos. 66, 74, 80-82, 87, 88, 91-93, 95-97 and 100 (fig. 11; pls. XX and XXI A) illustrate the wide range of flake- and blade-scraper facies prevalent in the Nagarjunakonda valley and are typologically ascribable to the Upper Palaeolithic or Mesolithic series. They show the domination of function over shape in their asymmetric and atypical forms and indicate, by their delicately-retouched sides, the functional variation over the Lower Palaeolithic scraper-types.

(xiv) *Retouchers*

No. 77. Primary and secondary flakings.—Unique type, about 3 in. long, on coarse-grained cherty quartzite, with a triangular cross-section throughout, attained by a flattish, scarred underside and a longitudinal mid-rib on the upper side and with both the terminals pointed. The side-margins and ends reveal elaborate retouch. It could efficiently have served as a retoucher and is the first of its kind in the Middle-Upper Palaeolithic industries of the Deccan.

Type.—Middle-Upper Palaeolithic retoucher.
Fig. 11; pl. XX B.

No. 78. Similar to the above, but of about half the dimensions of the former, and a much more perfect and delicately-retouched specimen on fine-grained mottled chert.
Fig. 11; pl. XX B.

(xv) *Burins*

Nos. 49 to 58. This group is variously made on different materials like silicious rocks, either jasper or jaspery quartzite or chert, and quartzite. No. 49 is mainly a scraper showing steep and delicate nibbled retouch at the bottom and right marginal edge, but transverse burin-faceting on the

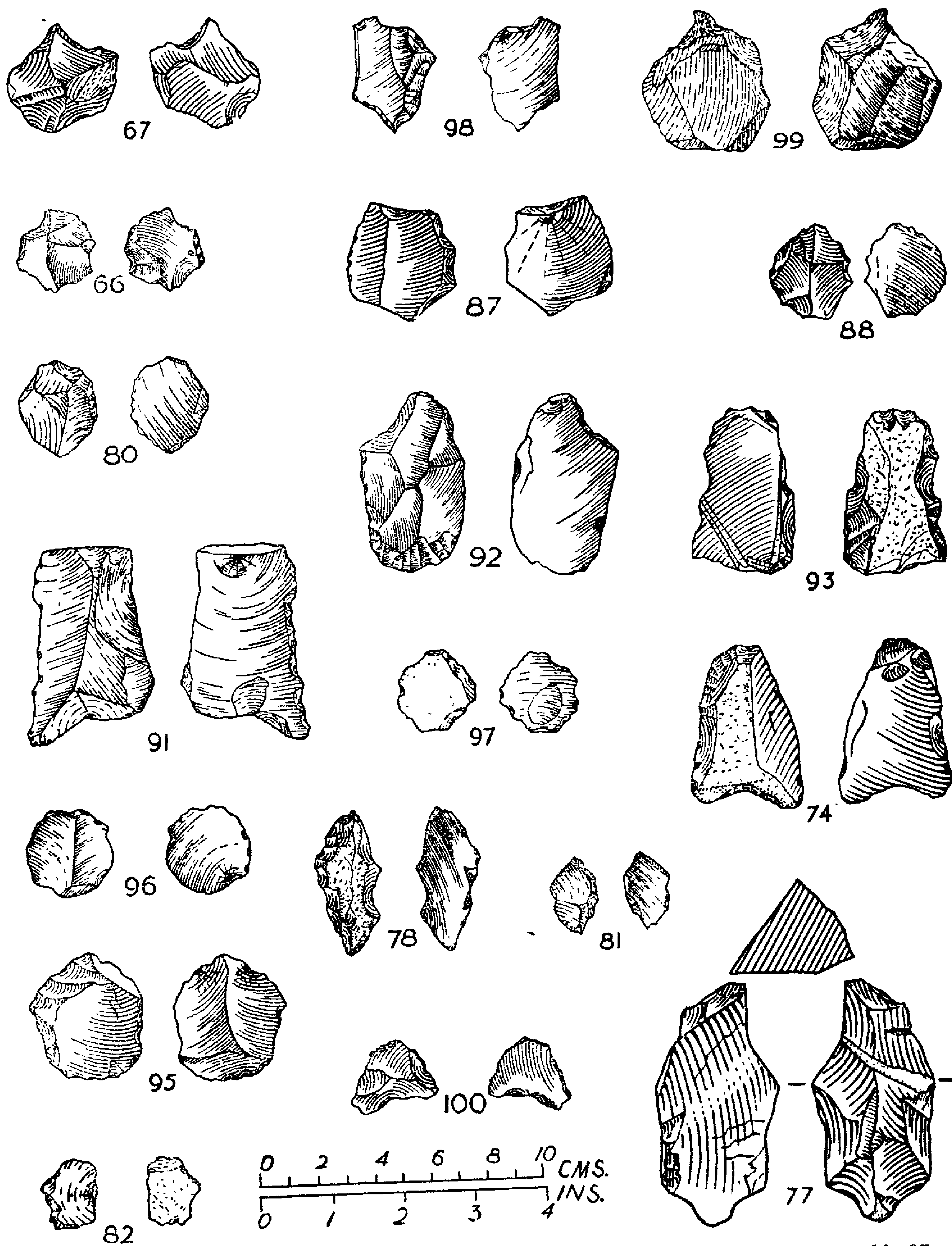


FIG. 11. *Palaeoliths from Nagarjunakonda: 67, 98 and 99, awl-points; 66, 74, 80-82, 87, 88, 91-93, 95-97 and 100, medium-to-diminutive scrapers; 77 and 78, retouchers*

upper left corner, the opposite edge being retouched. No. 50 has an efficient angle-burin facet on the converging bottom of thick flake, the opposite edge being carefully trimmed. A part of the right margin carries a notched scraper-edge. No. 51 is a flake on green jasper with an angle-burin facet neatly got and with retouch effected on the edge opposite to the burin-scar, which is continued up to the striking platform of the flake and ends in an awl-like point there. A part of the side-edge near this point is trimmed as a scraper-edge. No. 52 is made of quartzite and is an asymmetric flake, shaped like an arrow-head, with a deep angle-burin scar on the apex and with a notched hollow scraper-edge on the opposite margin. No. 53 is a thick flake, the round bottom edge of which has a cortical surface and the upper part is turned into a powerful screw-driver type burin-edge, opposite

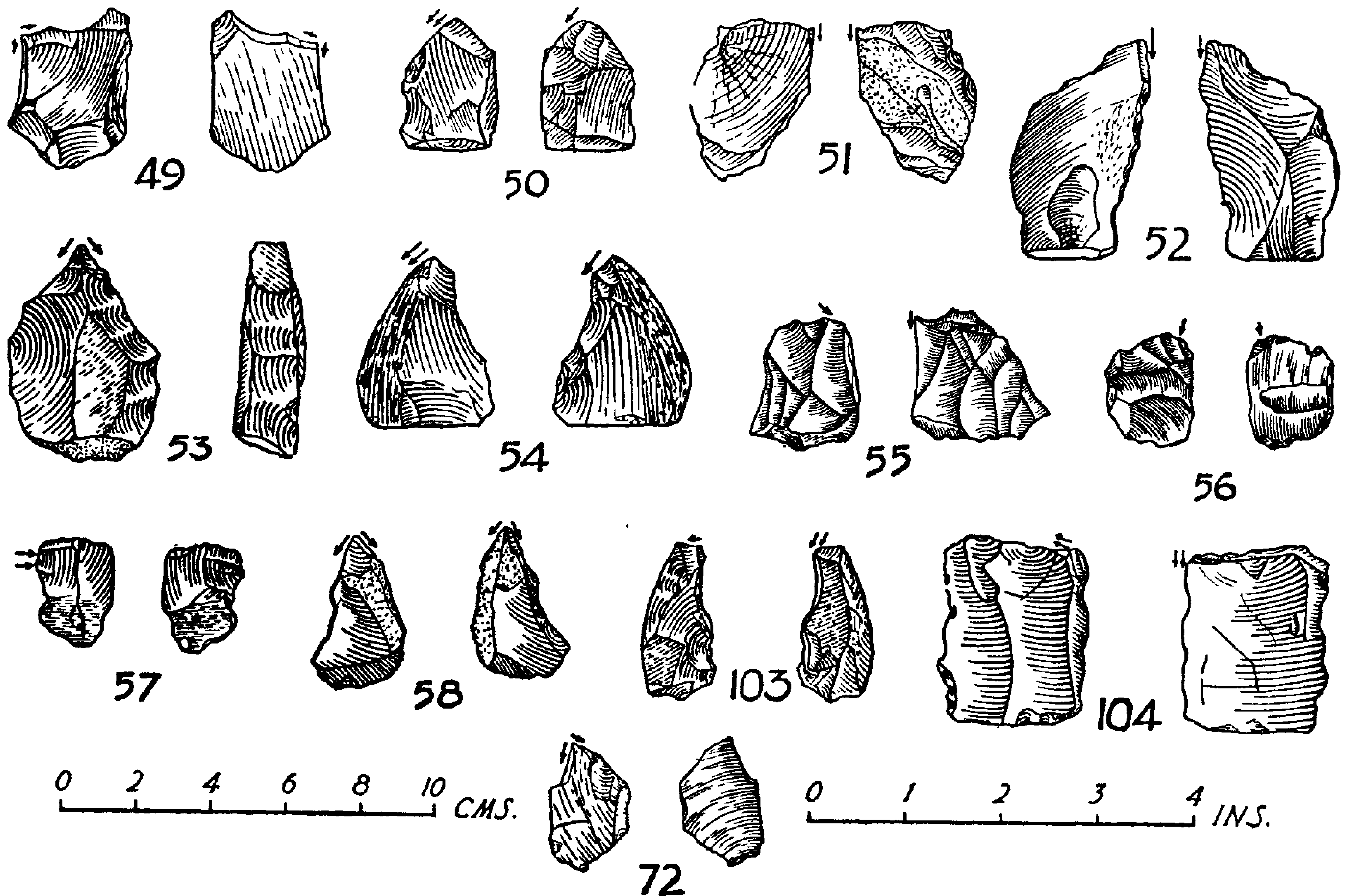


FIG. 12. *Palaeoliths from Nagarjunakonda: burins*

a carefully-trimmed and retouched margin. Nos. 54 and 55 are cores: no. 54 has a heavily-patinated cortex, and a part of the edge is steeply flaked as a chopper or scraper, one end of the edge being made into a *bec-de-flute* burin-edge; no. 55 is a small irregular lump, at one edge of which is made an awl-like point and at an opposite point a nucleiform burin-edge. No. 56 is a short thick prepared-platform flake on fine-grained chocolate-brown quartzite with sharp side-edges; while one of the edges is retouched as a steep-ended scraper, the opposite one has two deep and short spalls removed as in a burin-edge. No. 57 is a triangular lump of jaspery sandstone with weathered calcareous patch at either end and with a *bec-de-flute* burin-edge at one end of one of the three sharp sides. The tool was found in the erosional wash-deposit near the cemented gravel-bed in Locality C. No. 58 is a flat elongated lump of jaspery quartzite with a weathered cortical patch along one margin of it; the opposite margin shows steep secondary trimming, and on one of its ends is an angle-burin facet.

Type.—Upper Palaeolithic or Mesolithic burin-*cum*-scraper tools.
Fig. 12; pl. XIX B.

No. 72. Fine specimen of angle-burin on greenish fine-grained chert flake.
Fig. 12; pl. XVIII B.

Nos. 103 and 104. The first is a *bec-de-flute* burin on an atypical core, and the second a composite burin-*cum*-side-scraper on a flake-blade. The burin-edge is of the multiple-spalled, transverse burin-type, and its scraper-edges show delicate retouch. This specimen came from a spot immediately outside the Nagarjunakonda valley and might have found its way there by the movements of the Stone Age man around the valley.

Fig. 12; pl. XXI C.

(xvi) *Fluted cores*

Nos. 83 and 102. Fluted cores, out of which blades have been removed: while the former shows a double platform at the upper and lower ends, the latter has an essentially conical shape and a dished platform, and the flake-scars converge towards the apex of the core. Both the specimens are on quartzite and are approximately of the same size.

Fig. 13; pl. XX B and XXI B.

(xvii) *Bifacial points*

Nos. 85 and 86. Diminutive, bifacially-worked points of quartzite, which, by their form and features, suggest their function as probably that of thrusting points, not unlike the advanced Fauresmith or Early Still Bay points of Africa. They have sharp margins and tips.

Fig. 13; pl. XXI A.

(xviii) *Shouldered arrow-head*

No. 89. Primary and secondary flakings.—Unique specimen of a single-shouldered arrow-head, with a large flake-scarred underside and faceted tang-end. The side-edges and the shoulder are carefully retouched, and the upper side is mainly of cortex.

Type.—A seemingly-unfinished tool, reminiscent of the African Aterian arrow-heads.

Fig. 13; pl. XXI A.

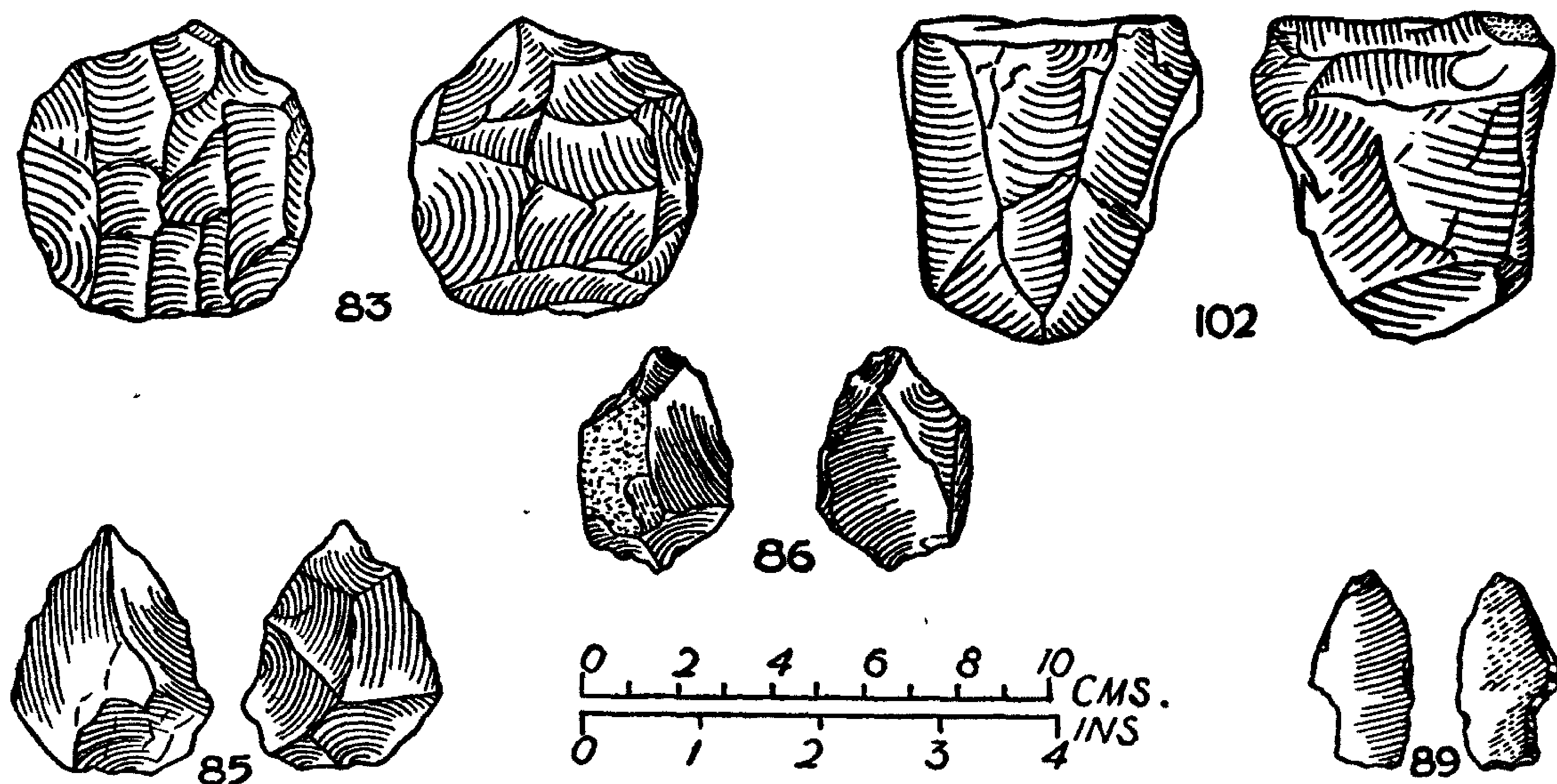


FIG. 13. *Palaeoliths from Nagarjunakonda; 83 and 102, fluted cores; 85 and 86, bifacial points; 89, shouldered arrow-head*

3. THE PALAEOLITHIC INDUSTRY OF KAREMPUDI

A. Introduction

The site near Karempudi (lat. 16°26′N.; long. 79°43′E.), 32 miles to the east-south-east of Nagarjunakonda, was accidentally discovered by the writer in November 1956, when the flood-plain of the Naguleru river, above the casueway near Karempudi, yielded, on a quick search, a few tools of Lower Palaeolithic character. In order to gauge the potentiality of the site, the writer intensively explored its vicinity shortly afterwards, when a sizable collection of tools was made.

It stands revealed by the character of the collection of tools, which were largely *in situ* or in their original levels excepting the group gathered straightaway from the flood-plain of the Naguleru at Locality II, that the industries, typologically speaking, are clearly restricted to the Lower Palaeolithic, reaching perhaps the Middle Acheulian stage with the beginnings of Levallois flaking. Of utmost importance, however, is the fact that of the five main localities examined, four in the main stream of the Naguleru and one on its eastern affluent, Locality I, on the eastern affluent, yielded largely pebble tools (akin to Oldowan of Africa) with or in a matrix of an early Abbevillean biface-assemblage, but clearly outnumbering the latter. On the other hand, the beds and sections of the main river in Localities II, III, IV and V yielded Abbevilleo-Acheulian tools and flakes, both Clactonian and Proto-Levalloisean, but, as far as the writer could see, to the exclusion of pebble tools. This is a unique evidence at one and the same station and has far-reaching implications to be analysed further on (below, pp. 80ff.). It may only be stated here that the evidence tends to place the pebble-tool facies on a firm footing, at least for this area.

B. Stratigraphy

The aim of the exploration was to see if the scattered tools collected during the first discovery could have any locale or were merely of a secondary and sporadic occurrence in the gravel-bed. To ascertain this, it was essential to find out if the neighbourhood of the Naguleru (fig. 14) could have supported any Stone Age settlement, as revealed by the cliff-sections and bank along its course and those of its feeder-streams.

The immediate west of Karempudi shows a rising land-contour, and it was hence thought that this high ground, to a mile east of the Naguleru Vagu, should first be examined and then one must approach towards the present bed. In this attempt, it was discovered that the bank of the feeder-nullah situated on the high ground itself contained Stone-Age relics. In Locality I (pl. XXII A), to the immediate north and south of the road between milestones 63 and 64 on the main, i.e. eastern, limb of the feeder-nullah, as also on the road cutting close by (pl. XXII B), the stratification was as follows. A weathering zone—apparently of the upturned edges of the sharply-tilted limestone-beds—which was 5 ft. thick and mainly comprised highly-pulverized *kankar*-mixed earth (A on pl. XXII B), had above it, formed due to capillary attraction, a heavy calcareous sheet *kankar*-bed (B on pl. XXII B). This bed is seen over a great area of this part of the District and has been extensively used in constructions (pl. XXIII A), but, where nullahs run and pebble-shingles gather, the *kankar*-bed—apparently during its consolidation—had collected pebbles and angular rocky fragments coming from the Cuddapah quartzite hills near by. At other places, it is devoid of this agglomeration (pl. XXIII A).[1] According

[1]It may be mentioned here that at many places even at Nagarjunakonda, this highly consolidated

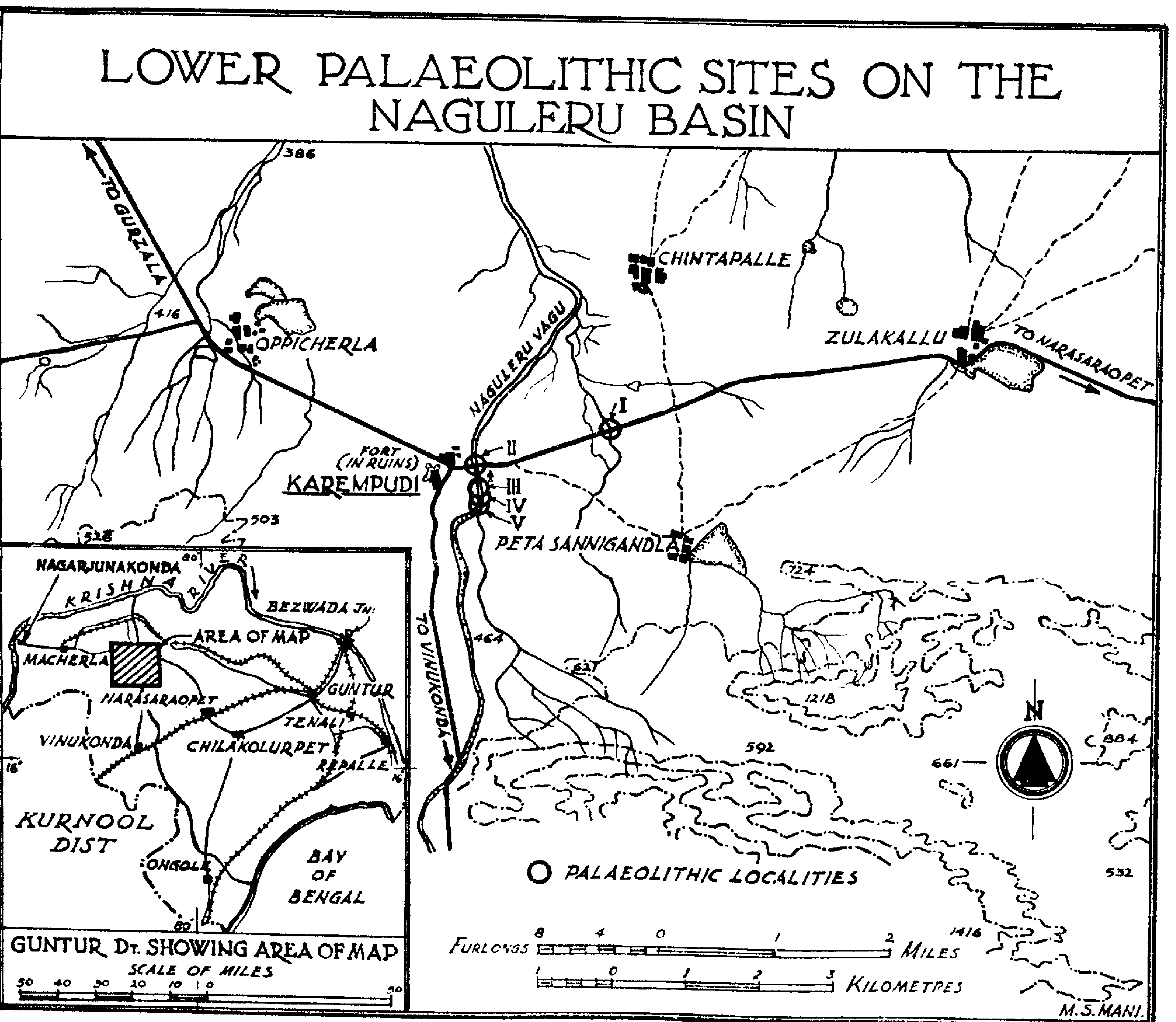

LOWER PALAEOLITHIC SITES ON THE NAGULERU BASIN
TO GURZALA
OPPICHERLA
CHINTAPALLE
ZULAKALLU
TO NARASARAOPET
NAGULERU VAGU
FORT (IN RUINS)
KAREMPUDI
I
II
III
IV
V
PETA SANNIGANDLA
TO VINUKONDA
N
PALAEOLITHIC LOCALITIES
FURLONGS
MILES
KILOMETPES
M.S.MANI.
NAGARJUNAKONDA
KRISHNA RIVER
BEZWADA Jn.
AREA OF MAP
MACHERLA
NARASARAOPET
GUNTUR
TENALI
VINUKONDA
CHILAKOLURPET
REPALLE
KURNOOL DIST
ONGOLE
BAY OF BENGAL
GUNTUR Dt. SHOWING AREA OF MAP
SCALE OF MILES

Fig. 14

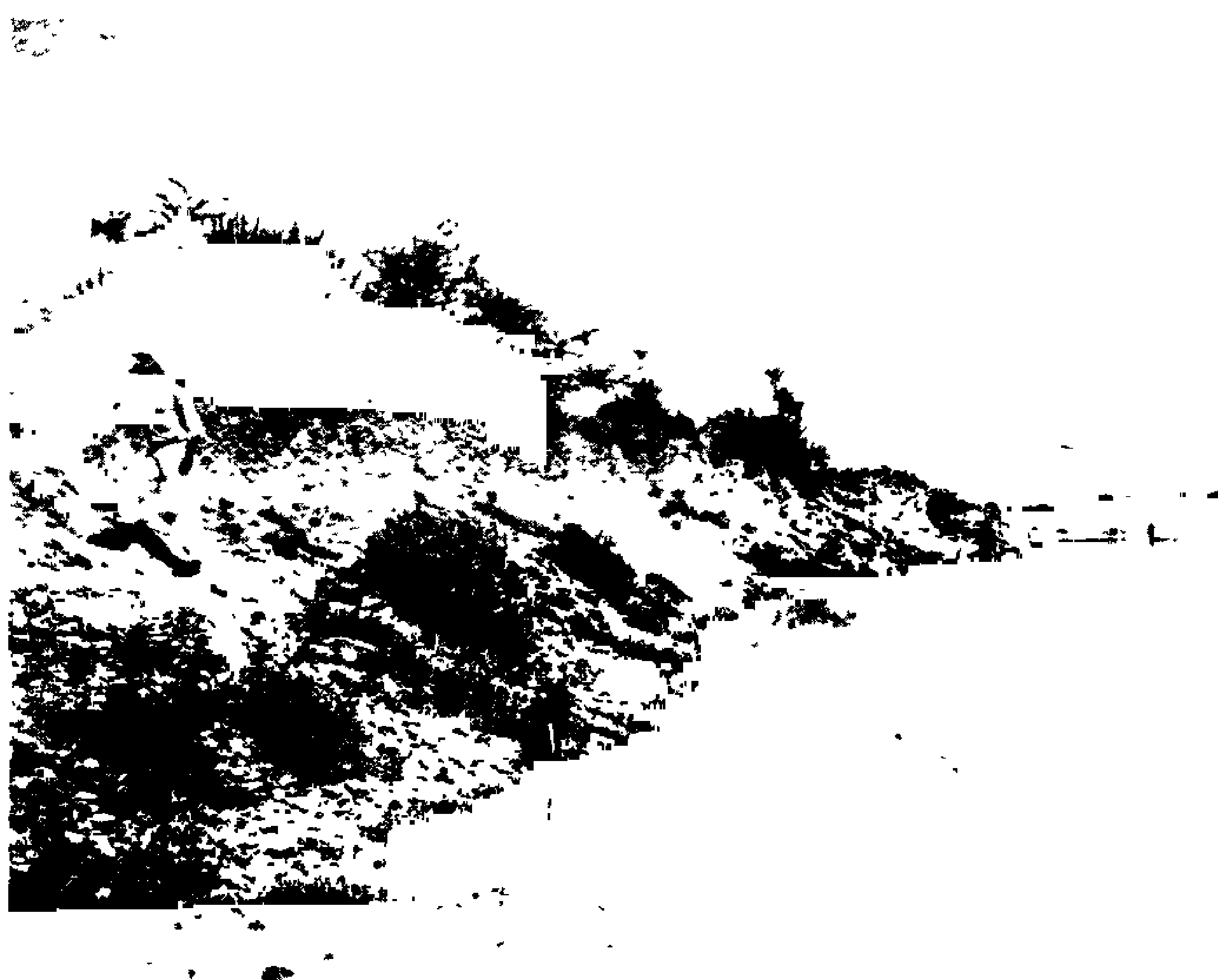
to a cursory observation, this conglomerate did not yield tools. Resting unconformably over this and with a thin mantle of silt underlying it was a packed gravel-layer (C on pl. XXII B), on an average 5 ft. thick, which contained both angular quartzitic fragments as well as pebbles and tools laid in a diminishing order of size by the aggrading stream. This was succeeded by a silt-deposit (D on pl. XXII B) of an average thickness of 3 ft. The high bank was also strewn with a profuse scatter of shingle, rock-fragments and tools. The tools from Locality I had been mostly recovered from the section and the *talus*-slopes. As one approaches the Naguleru river along the main road, the ground loses height and the bank of the river, even where preserved to the maximum height (in Localities V and VI), would appear to be considerably lower than the high ground of Locality I.

The section of the Naguleru itself was studied at four spots, respectively indicated as Localities II to V (fig. 14; pls. XXII B, XXIII and XXIV), besides a well-section on the bank near Locality IV. Despite the relative difference in the height, the section had a rough uniformity in the succession of deposits, on the same lines as that of the feeder-nullah but with the difference that the further upstream one goes, at about water-level the pebble-bed layer started and continued often for a maximum of nearly 10 ft. with an intervening silt-layer—as observed in Locality V—and was succeeded by a brownish silt-deposit of 4 to 5 ft. thickness. The basal substratum, not exposed at any of the examined places, was covered either by water or *talus* and flood-plain silt, since nearer the village the stream spreads out like a fan and has unloaded a heavy shingle-cover on the flood-plain terrace (pls. XXIII B and XXIV A). The substratum may perhaps be available if one could explore the upper reaches of the river, but a long nullah, which joins the Naguleru near Locality V from the east, prevented even a close examination of Locality VI and much more so of the river further south, as one had to make a very devious detour to get across to the other side, which would take a long time. As the succeeding pages detailing the character of the lithic industry would clearly indicate, it would indeed be fruitful to explore thoroughly both the upper reaches of the river at least up to the place 4 miles upstream from Karempudi, where it cuts a gorge and is crossed by the Karempudi-Vinukonda road as it emerges into the plain from the quartzitic hills, and its lower reaches to its junction with its feeder-nullah (with Locality I already described), which is about two miles down Karempudi.

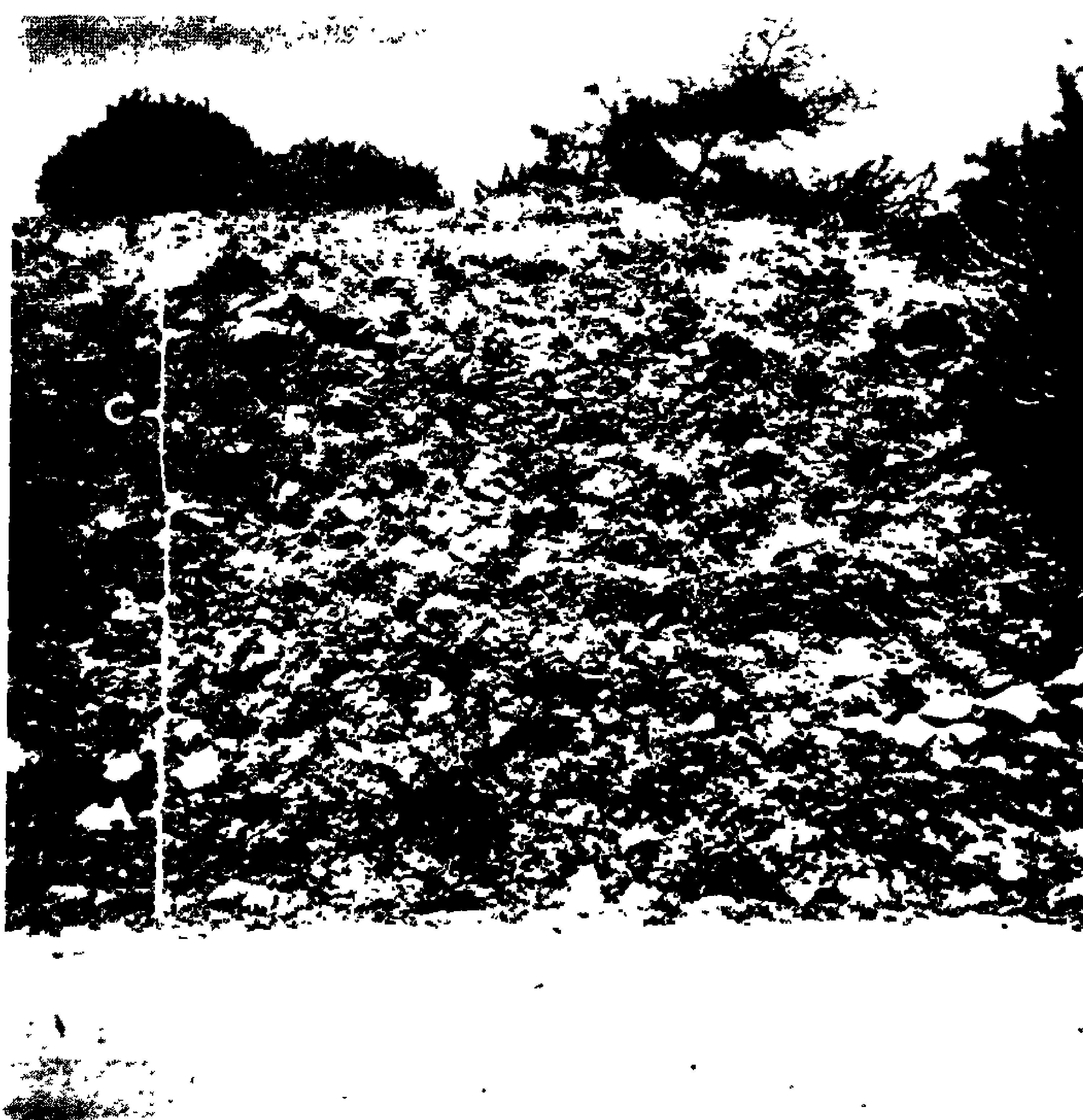
C. The tools

Upwards of sixty tools were collected from the different localities, of which the majority, aggregating to twentyfour and twentyfive, were respectively from Localities I and II. A *prima facie* prominent feature of the group from Locality I, where an attempt was made to bestow on the collection a comprehensive character by picking tools at all stages and flakes also (fig. 15; pl. XXV A), is the preponderance of pebble cortexed tools (Table, below, p. 83), recalling the lowest-stratum tools of the Madras culture and having their parallels outside India in the Oldowan of east Africa. The other components of the collection from this Locality are Early Abbevillean crude bifacial *coup-de-poing* and thick heavy flakes of Clactonian character. Interest would also attach to the presence of one probable tool of Victoria West technique of side-blow flaking. The pebble-made tools exhibit a great variety, being unifacial and bifacial, with fan-shaped flaking on a split pebble and pebble-cortex butt with keeled and chipped end respectively,

kankar top-surface, with *kankar*-mixed powdered earth below, and hard rock underneath, was seen in the middle high ground (Locality E) in the small pits that were dug.



A. *Karempudi: cliff-section at Locality I. See page 78*



B. *Karempudi: road-cutting between 63rd and 64th milestones. See page 78*

To face p. 80



A. *Karempudi: roadside section showing Kankar bed and underlying pulverized 'B' horizon. See page 78*



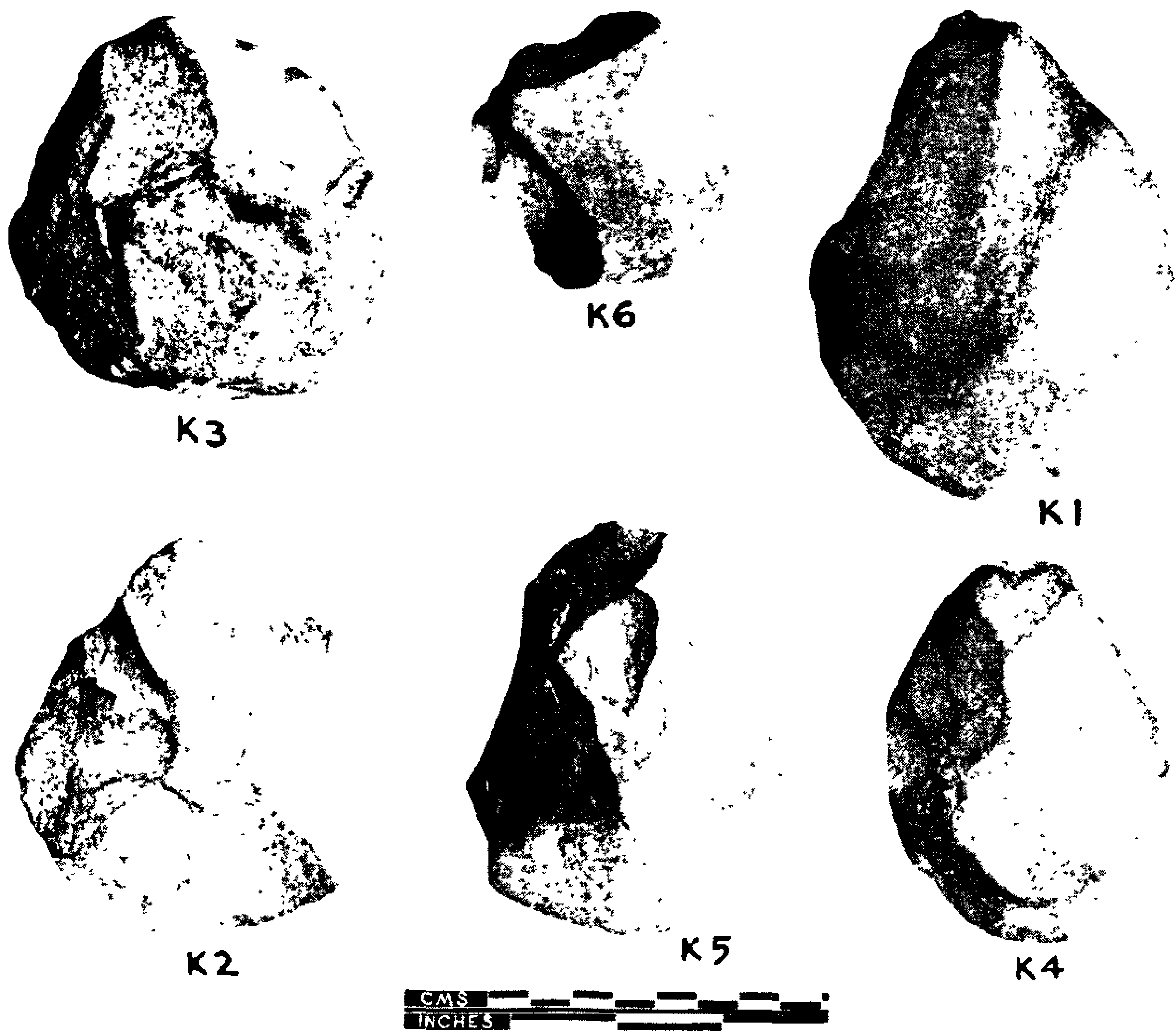
B. *Karempudi: flood-plain gravel and tilted basal limestone on the bank of the Naguleru stream. See page 80*



A. *Karempudi: Naguleru stream at Locality II showing its meandering course and wide flood-plain.* *See page 80*



B. *Karempudi: section on Naguleru stream at Locality III.* *See page 80*

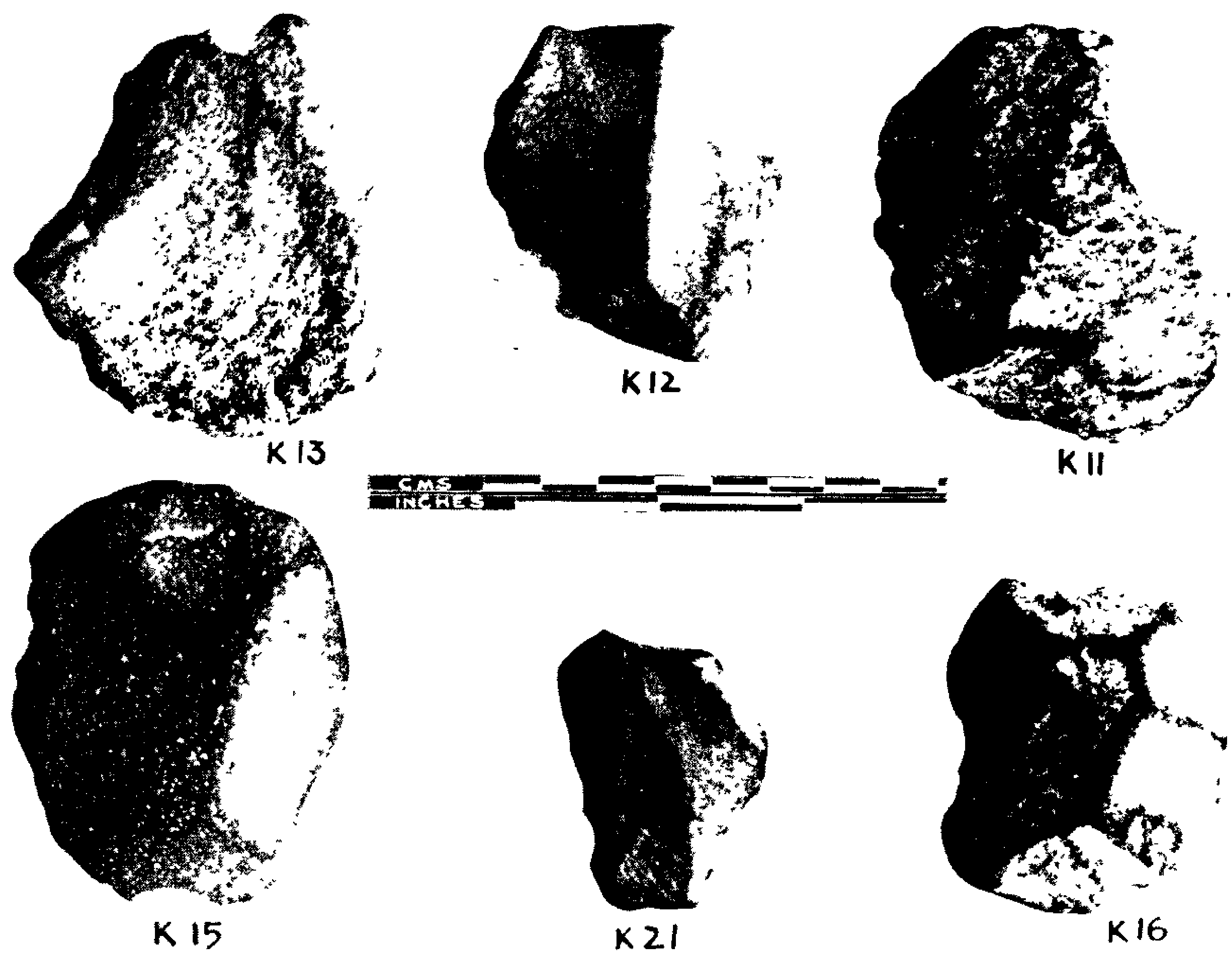


A. *Karempudi: palaeoliths from Locality I. See page 80*

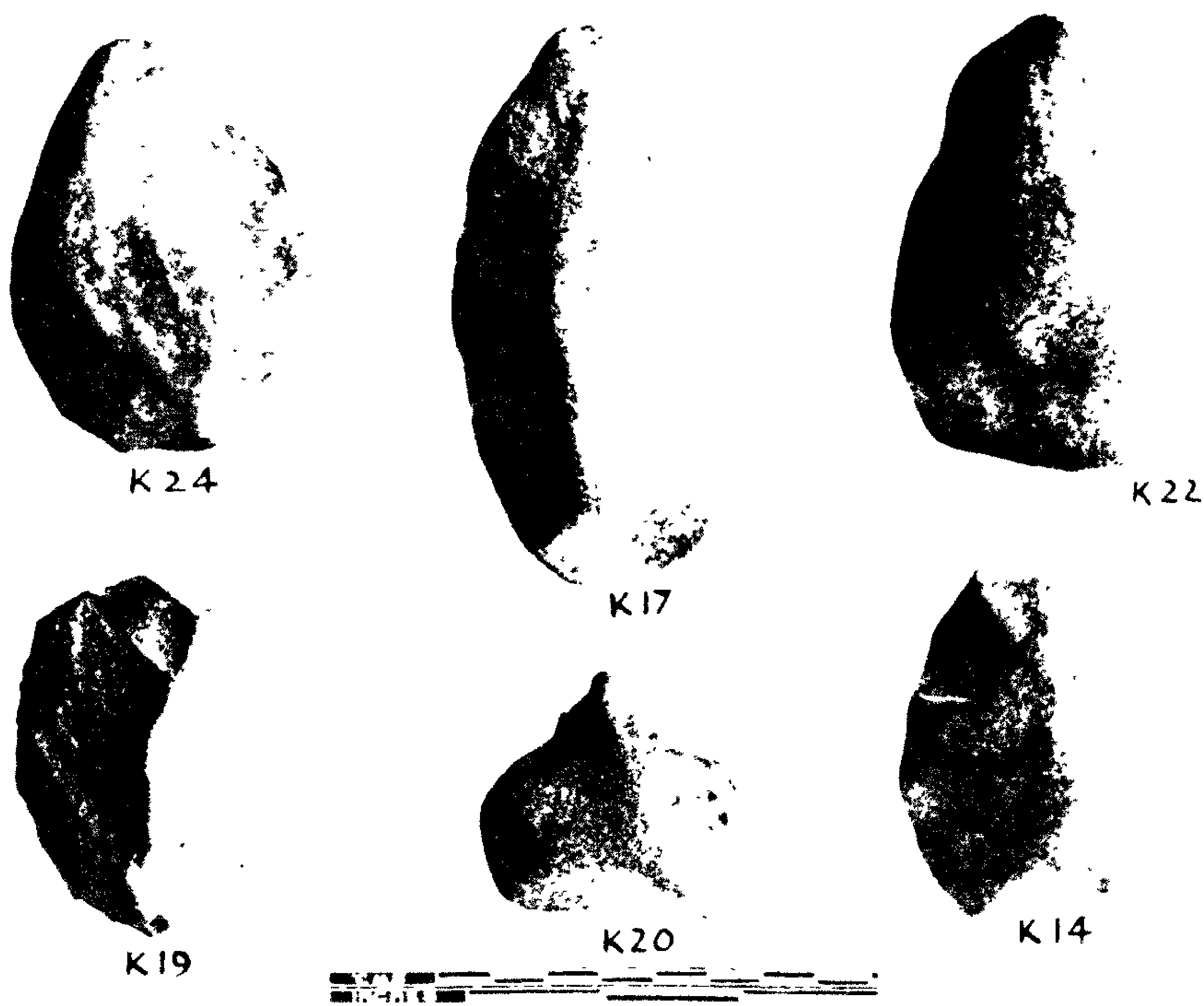


B. *Karempudi: palaeoliths from the flood-plain at Locality II. See pages 81 and 82*

To face pl. XXVI

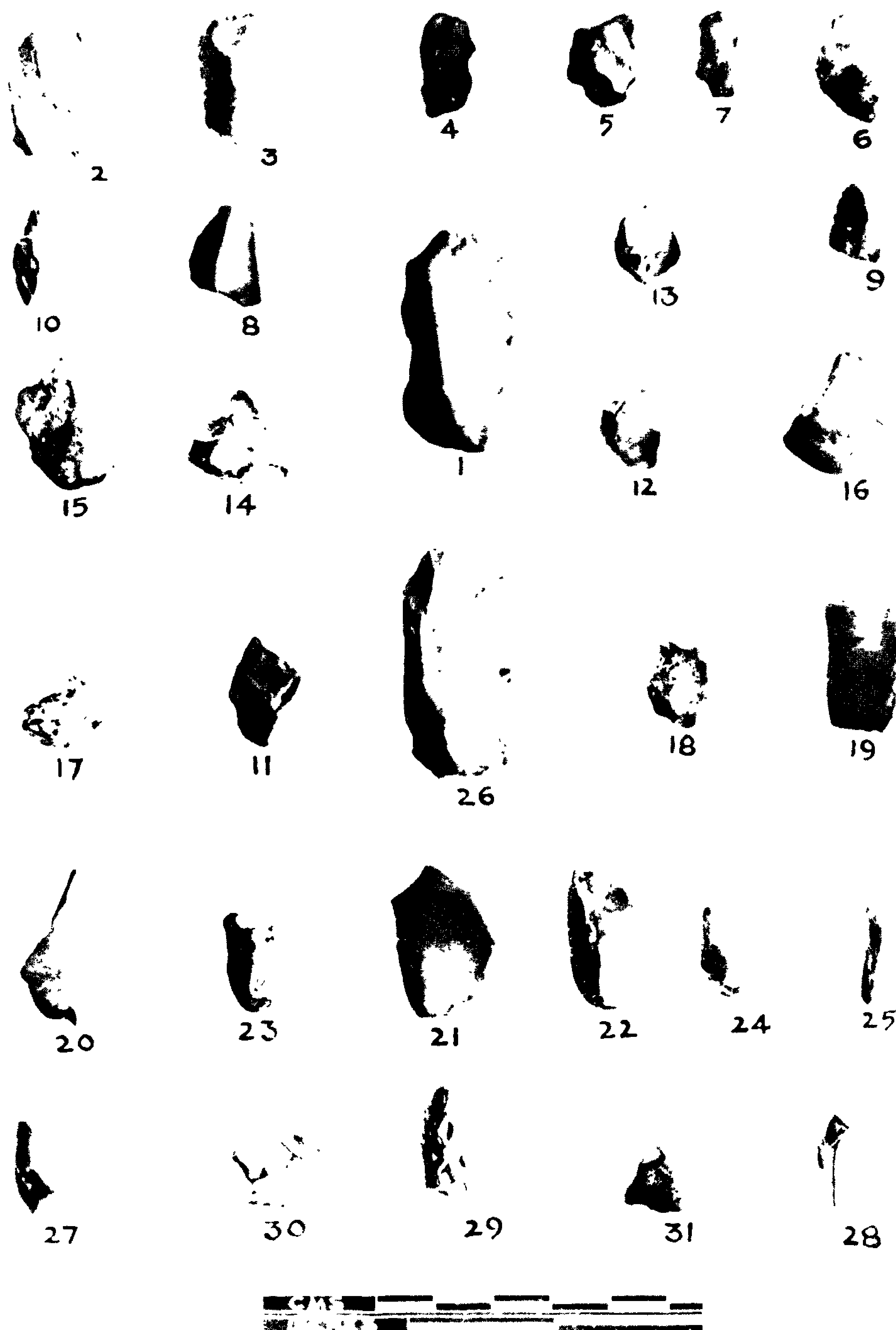


A. *Karempudi: flake-tools from the flood-plain at Locality II.* *See page 82*



B. *Karempudi: palaeoliths from sections at Localities III and IV.* *See pages 81 and 82*

To face pl. XXV



Microliths from Nagarjunakonda: 1-4, backed blades; 5-7, crescentic tools; 8-14, points; 15-18, perforators; 19, chisel; 20-24, burins; 25-31, scrapers. See pages 90-93

To face p. 81

and this demonstrates their richness and inherent variety. However, this is not to say that they are independent of the bifaces, since some of them show a careful evolution into the Abbevillean bifaces in their types and are, besides, generally found in an indubitable association of the latter. Their origin in the early stages of the Lower Palaeolithic is thus clearly manifest and is of some consequence when the tools from Locality II on the main Naguleru river are compared with them. It is admitted that the collection from Locality II was made entirely from the flood-plain gravel-bed directly. At the same time, this, together with the general range and character of such other tools as were picked up—almost invariably from the implementiferous gravel-bed in the sections in Localities III to V,—would vouch for the fact that, whatever other tools they were rich or deficient in, the pebble tools are quite conspicuous by their total absence from the main Naguleru section and bed in the examined localities. Herein lies the contribution of the palaeoliths from the vicinity of Karempudi, viz. the suggestion of the relative chrono-typological position of the pebble tools *vis-a-vis* the bifaces.

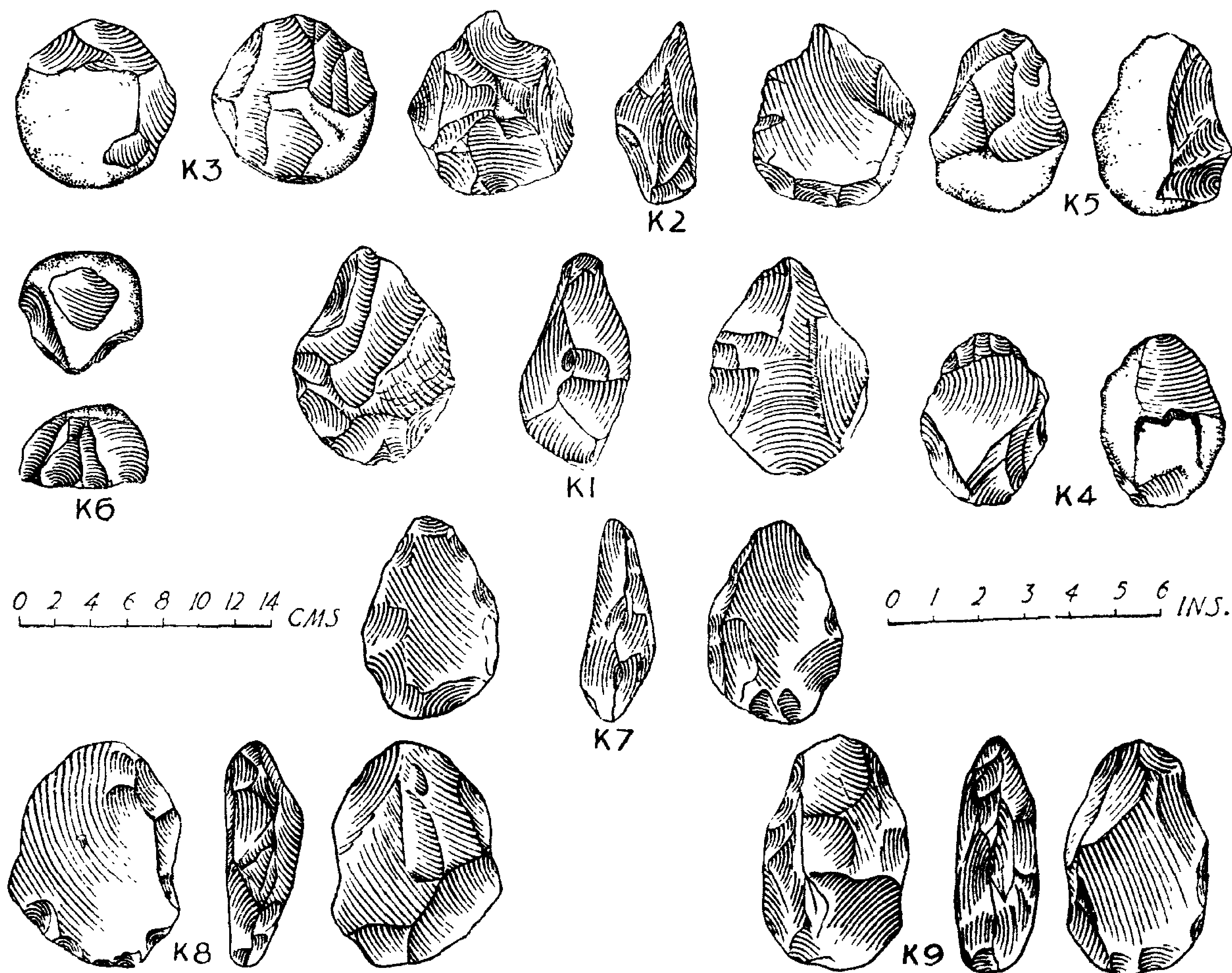


FIG. 15. *Palaeoliths from Karempudi: K1-K6, from Locality I; 7-9, from Locality II*

We do have a few Abbevillean crude bifaces in the latter localities on the main stream besides the progressive types in the Acheulian biface group, which can demonstrate

the continuity of cultural evolution as is extant in the Naguleru basin as a whole (fig. 16; pls. XXV B and XXVI). They would perhaps show that in the earlier stages the palaeolithic man settled on the banks of the affluent around Locality I, for reasons not readily explicable, and at a subsequent stage shifted his operation to the banks of the main stream. By this time, he had also given up the fabrication of pebble-made tools and was on the steady path towards a further bifacial tool development. As for the later limit, typologically speaking, which the Naguleru basin palaeolithic tools portray, it was

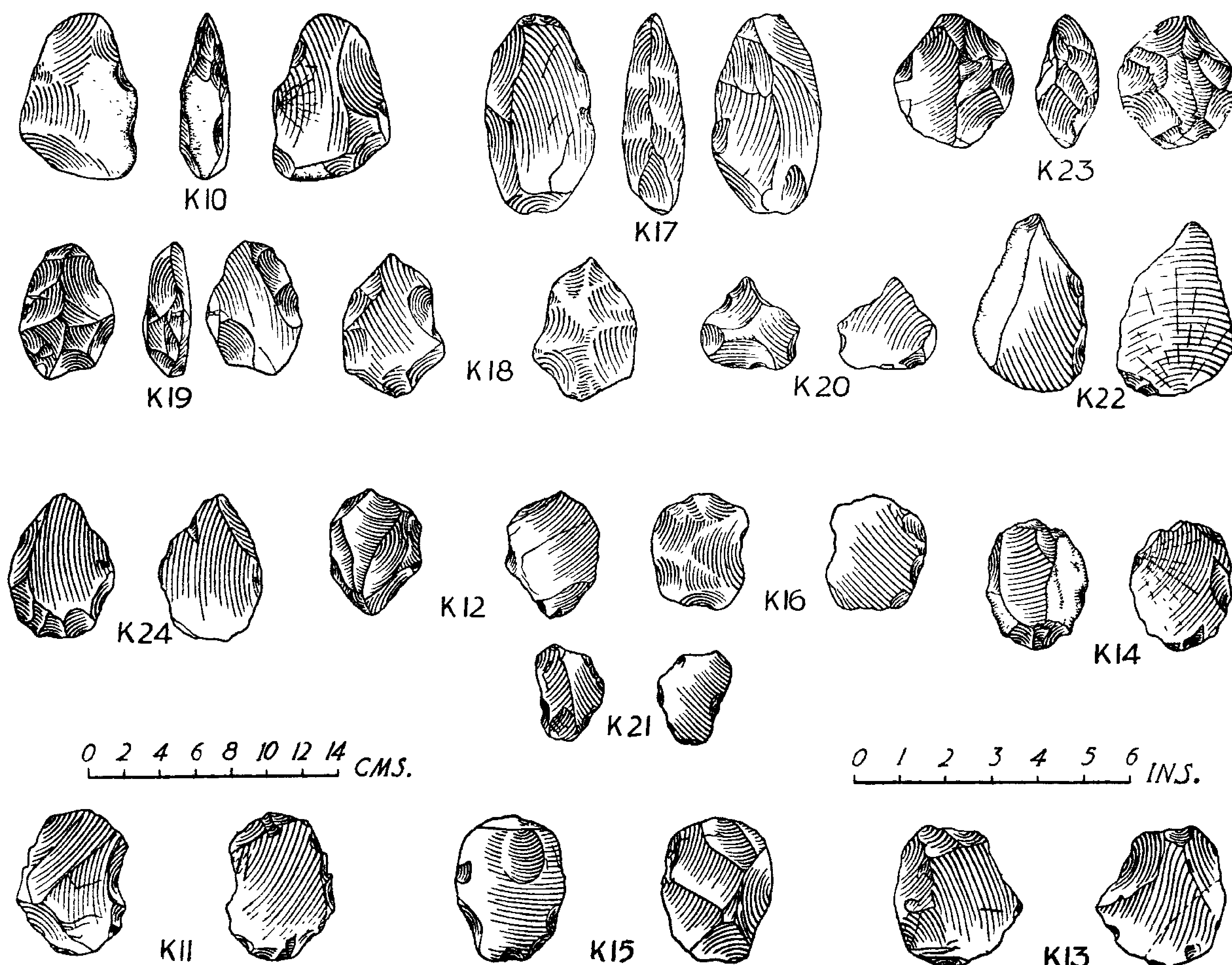


FIG. 16. *Palaeoliths from Karempudi: from Localities II to V*

observed that proto-Levallois flakes and, to a lesser extent, Levallois flakes were existent even in this limited collection under study, thereby suggesting that a Middle Acheulian stage had been reached (fig. 16; pl. XXVI A). This is also reinforced by the occurrence of two rolled cleavers in the collection from Locality II. In fact, though cleavers were rather poorly represented in the collection, this itself might also support the contention that the development of the handaxes noticed in the collection is not considerable. A passing mention may be made of a perforator or awl of flake-tool which was found on the surface in Locality IV.

D. Conclusion

As outlined above, the limited exploration carried out in the Naguleru basin in the vicinity of Karempudi tends to spotlight the relationship of the pebble and bifacial tools, particularly *vis-a-vis* the Nagarjunakonda tool-industries. In Locality I, we have the pebble-tool facies in good strength and bulk, in clear companionship with the Abbevillean crude bifaces. In Localities II to V in the main river-course, however, we miss the pebble tools completely and, on the contrary, have a sprinkling of the Abbevillean bifaces and a steady development in the bifacial tradition, with the attendant progress in the flake-technique. In Locality I, the flakes, such as are available, are of thick and rudimentary Clactonian character. In the other Localities, II to V, on the main river, however, the bifaces and flakes both tend to suggest a comparatively evolved nature.

STATISTICAL TABLE OF TOOLS FROM THE NAGULERU BASIN

Type / *Locality*	*I*	*II*	*III*	*IV*	*V*	*Total*
Pebble tool	12 *50*	...	...	...	...	12
Abbevillean biface ...	7 *29*	3 *12*	1 *20*	...	1 *20*	12
Acheulian biface Handaxe	...	3 *12*	2 *40* (Handaxe and Cleaver together)	1 *20*	1 *20*	9
Cleaver		2 *8*				
Victoria West (?) ...	1 *4*	1 *4*	2 *40*	1 *20*	2 *40*	7
Clactonian flake and scraper	4 *17*	5 *20*	...	2 *40*	1 *20*	12
Clactonian core ...	...	3 *12*	...	...	...	3
Proto-Levallois flake ...	...	5 *20*	...	1 *20*	...	6
Levallois flake	...	3 *12*	...	...	...	3
Total ...	24	25	5	5	5	64

N.B.—*The figures in italics represent the percentage of the respective type in the total collection from each Locality.*

Further systematic exploration should yield a rich harvest of tools *in situ* and valuable stratigraphical data which might throw pointed light on the palaeolithic problems of this region as a whole and also contribute towards correlations with stratigraphic sequences of other areas with allied industries. Particularly, the calcareous conglomerate underlying the implementiferous gravel would bear a closer examination at a number of places, to see whether it also bears tools or not.

4. DISCUSSION

As the composition of the aforedetailed Nagarjunakonda collection is governed to some extent by fortuitous factors, and as exhaustive collections were not made from the examined localities, any statistical table of the available tools is liable to be unrealistic. Nevertheless, the quantity and significance of the tool-types in the valley may be discussed, particularly in the light of the Lower Palaeolithic site near Karempudi, and, as a sequel, certain technological and cultural problems may be brought to the fore.

At the outset, it can be said that the pebble-tool component is feebly represented in the valley, thus vouching for the primitive stage such tools occupy in the Madras bifacial family. Actually, handaxes and other true bifacial tools are much more frequently observed in the valley than pebble tools. No doubt, the latter are of both unifacial and bifacial trimmings and show many sub-types, but no independent industrial origin could be attributed to them.

One of the obvious problems of palaeolithic archaeology in India is the relative origins of the pebble tools which are associated with the true Madras bifaces in their early stages and the pebble tools of the Sohan industry of Panjab and the north-western sub-Himalayan tracts brought to light and interpreted by De Terra and Paterson. Recent work by Lal in the Beas valley has focussed further attention on this issue. The inherent pattern of the pebble tool *plus* Levallois flake in the Sohan is clearly absent in the presumably-allied pebble-tool industries of south-east Asia, viz. the Anyathian of Burma, the Choukoutienian of China and the Patjitanian of Java, as analysed by Movius. In these latter, the tool-outfit mainly consists of unifacial and bifacial pebble artefacts of the chopper-chopping tool, handadze and proto-handaxe types, without Levallois flakes. The proto-handaxe type is further said to be found only in the Javanese industry and not in others. It should, however, be mentioned here that the writer, while recently examining a collection from the Chinese Choukoutienian site in the Madras Museum[1] was able to see clear traces of the crude bifacial flaking technique in this industry, and even the resultant shapes of tools in some cases would be near that of a bifacial *coup-de-poing*. Despite the admittedly crude and clumsy execution it would indeed be worth while to note this trait in the industry. One of the tools in this collection further resembles what can be regarded as a proto-Levallois flake. The raw material, generally, is silicified tuff and fossil-wood at the Burmese and Javanese sites and refractory quartz at the Chinese site, and only crude chipping is thus possible. Even so, the basic homogeneity in evolution, technology and types is, to some extent, demonstrable in all the three zones.

The Sohan of India, on the other hand, with its clear Levallois-flake facies, is sharply different from the above three—despite its limited typological similarity in the pebble-tool types as shown by Movius. Added to this, a handaxe-industry—strongly suggestive of Madras cultural infiltration—seeps into the matrix as seen at Chauntra.

[1]By courtesy of Dr. A. Aiyappan, Superintendent, Government Museum, Madras.

In peninsular India, however, the available evidence is strongly in favour of a basic bifacial handaxe industry, manifesting in its earliest stages a pebble-tool facies as a crude primitive endeavour, fully within the cultural folds of the bifacial complex and disappearing by the Early Acheulian stage. The Kurnool and our Nagarjunakonda industries would both come within this ambit. The cultural affinity is markedly with the east and south African evidence—that of the Oldowan-beds I to IV and the Stellenbosch respectively. May not the pebble-element be even considered as akin to an essentially Clactonish core-and-flake assemblage in which the alternately jagged-edged core could have been employed as chopping tool? The palaeolithic folk need not have been tied down to one single trend only but could have experimented with many techniques simultaneously for the fabrication of tools, particularly in the incipient stages of tool-making. This is specially true of Kurnool and Nagarjunakonda pebble-facies, since, despite its relative feebleness, it displays many sub-types and forms, which, from techno-typological standpoint, imply or express mainly a Clacto-Abbevillean complex and would thus be contained within the bifacial family. Further, while the Oldowan, Kafuan and Pre-Stellenbosch are located mainly in the Lower Pleistocene, the south-east Asian pebble tools are rooted in the mid-Pleistocene. It is, in any case, a matter of fundamental empirical significance, and taxonymic considerations[1] need not bog us down in a comparison of peninsular pebble tools with their north-western (Sohan) counterparts which have an almost exclusive, full-blooded evolution in their own sphere.

Any generalized distribution-map of pebble tools in India is liable to leave the impression that here we have to deal with an industry which had only one focal zone, i.e. the Sohan, and that there was a differential diffusion from this zone to different parts of India right down to Madras. On the evidence of stratigraphy, typology and geography, this may be a fallacy. Due recognition need now be given to the clear distinction between what are pebble-scraper-flake tool assemblages culturally inspired and geographically influenced by the Sohan of the north-west and the admittedly primitive pebble-tool facies well within the bifacial core-tool family of the peninsula. The Madras-Vadamadurai boulder-conglomerate evidence, the Mayurbhanj evidence of Bose and Sen and the Bombay evidence of Todd—not to mention others of a less direct nature—would uphold such a distinction. Besides, if it is held that the Madras pebble-tool element was the result of the Sohan influence at its feeblest and most distant ambit, it would knock the bottom out of the chronological significance of the boulder-conglomerate of Madras—which is on the existing evidence, taken as stratigraphically equatable with the Pre-Sohan. One must need give some time-lag for one single industry to seep through a vast area and influence another divergent industrial zone, quite apart from other difficulties involved in the process. On the contrary, the interpretation of the southern pebble-tool element as a chthonic substratum of a different bifacial core-tool family would be indicated by the cumulative evidence of stratigraphy, geographical viability and extra-Indian parallels also. Specifically, two regions stand out in facilitating this interpretation: the Mayurbhanj and the Narmada-Sabarmati area.

In the former area, the observed stratigraphic sequence and, to some extent, the cultural material itself would clearly not lend itself to any Sohan or south-east Asian pebble-tool bias: on the contrary, the tool-development, even in the bifaces, is prominently deficient in the faceted-platform technique. As we know, if any technical accompaniment surely highlights the Sohan at its best, it is this Levallois flake technique. Now, the

[1]In much the same manner Bordes has desired the elimination of the Levalloisean in a narrow cultural sense for European assemblages and has defined it as one of the two basic flaking techniques often in use at one and the same time.

Mayurbhanj industry is not only lacking in this technique within its biface-development, which is directly derivable from the southern bifacial family, but also portrays a rather delayed beginning of the artefact-cultures and a rather slow pace of development thereof. Anyone familiar with the geographical environment of Mayurbhanj would appreciate that a culture-stagnation is not unlikely in the comparatively-isolated area that Mayurbhanj is. The lack of a virile faceted-platform technique for stimulating a progressive flake-evolution being glaringly manifest, the tool-types do not seem to have gone beyond the Middle Acheulian biface-stage.

In the Narmada area as well, it has been recorded that pebble tools and Abbevillean artefacts occur in the basal gravels and silt, and the upper gravels and clay are noted to have yielded an essential flake-industry accompanied by pebble tools and cores also. To these two Paterson gave the cultural labels ' Early Sohan ' and ' Late Sohan' and postulated an archaeological correlation with the Panjab Potwar sequence of lithic cultures. It is a moot point whether the Sohan pebble-Levallois culture had diffused so far south and at such an early stage as the basal gravels of the Narmada of the Mid-Pleistocene. In fact, this question is directly linked with another corresponding question: whether in the Panjab Potwar, the bifacial-handaxe culture existed earlier than the Early Sohan or *vice versa.* The labels of Paterson for the Narmada sequence therefore can be only tentative and will require scrutiny in the light of evidence from fresh sites and tools. At present, it appears more probable that the basal pebble-element of the handaxe-industries even on the Narmada must be a thing quite apart from the north-western Sohan pebble-industry. The stratigraphic occurrence of pebble tools in the form of a typologically Late Sohan assemblage together with advanced Acheulian bifaces at the Sabarmati sites, as suggested by Zeuner, does not militate against such a view, although this itself may need revision.

While in south-west Rajasthan, alleged Sohan tools have been recently found at sites near Chitorgarh, etc., in north-east Rajasthan the Lower Palaeolithic site at Bhangarh on Sanvan Nadi, District Alwar, discovered by the author, had a progressive pebble-tool group, and the Raipur (in the Yamuna basin) site of C. Maries (figs. 17-19)[1] would show mainly a predominant biface-element. The steady forging ahead of the southern biface almost up to the Panjab fringe is demonstrable; at the same time, the speed of southward infiltration of the Sohan would appear to be relatively less. The technological increment of these two distinct industries in a combined state in this area needs working out.

To resume our scrutiny of the collection under study. Here we have the typical bifacial handaxes and cleavers familiar to us from collections from other sites of the Madras culture or analogous tool-types from south Africa (above, p. 58). We have, besides, a slender small-sized cleaver with a parallelogrammatic cross-section and made by the same technique as the larger specimens (above, p. 68). We have also Mousteroid cores (above, p. 60). These would require a further careful examination by stratigraphical and cultural data from elsewhere in the vicinity. Nagarjunakonda also yields a very rich harvest of flake-blades, burins and a prolific variety of scraper-*cum*-points, in association with large prismatic cores, testifying to an Upper Palaeolithic assemblage (above, p. 60). There is no doubt about the strong representation of the flake-blade element in the valley.

Turning to the evidence from Karempudi for a moment, it may be recalled that the gravel-bed of Locality I gave only pebble tools and Early Abbevillean bifaces and a few plain-platform flakes (above, p. 80), while Localities II to V yielded an industry conspicuously lacking in pebble tools and showing unmistakable progressive trends within the

[1]Reproduced by courtesy of the authorities of the British Museum, London.

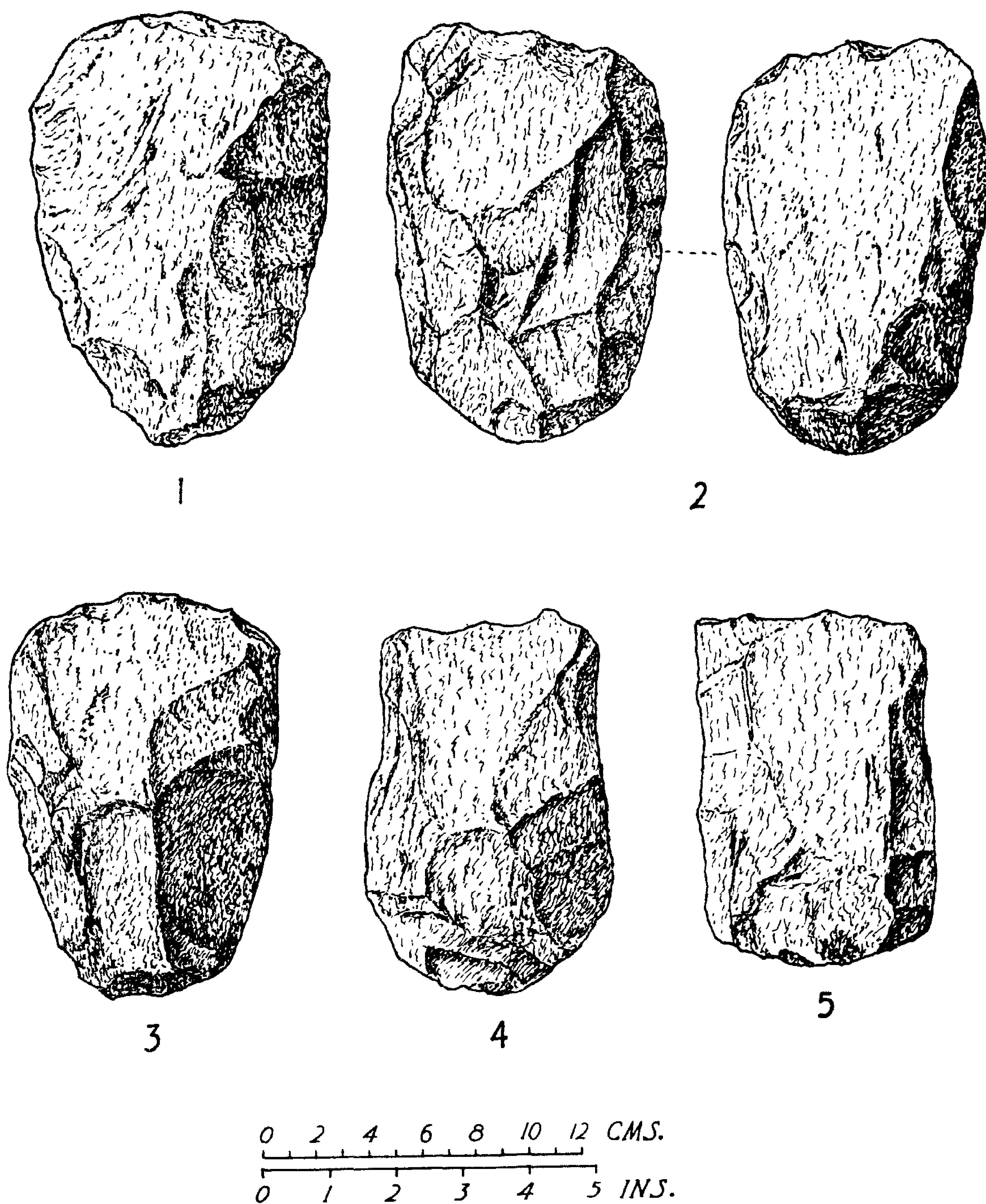


FIG. 17. *Palaeoliths from Raipur, C. Maries collection* (courtesy British Museum)

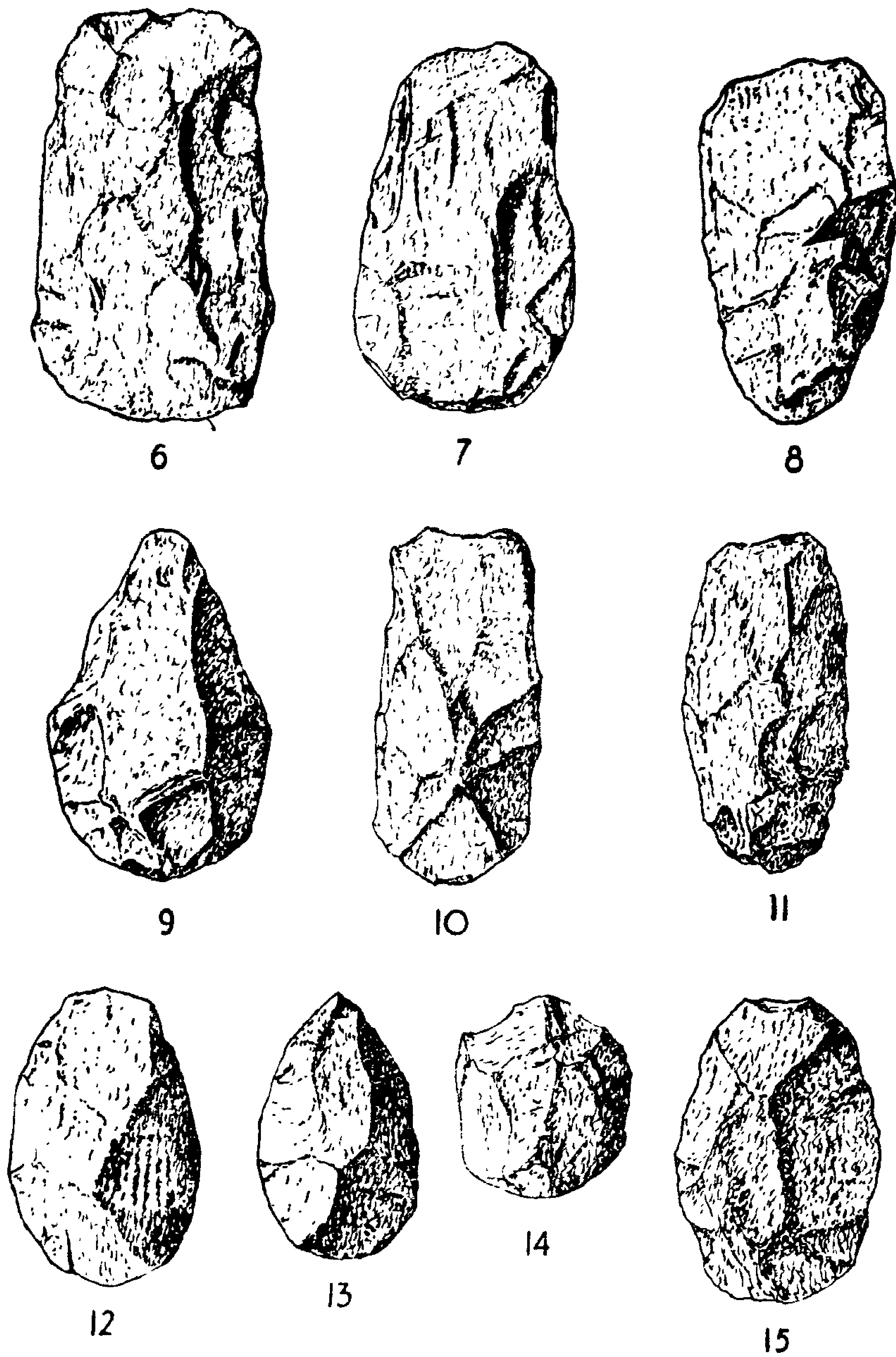


FIG. 18. *Palaeoliths from Raipur, C. Maries collection* (courtesy British Museum)

Lower Palaeolithic, reaching the prepared-platform stage in its flake-facies and handaxe-cleaver-scraper stages in the bifacial group. Considering the dominance of pebble tools and the meagreness of Abbevillean bifaces and thick plain-platform flakes exclusively along the western flanks close to the river Krishna at Nagarjunakonda (Locality D and adjacent areas) and near Lambadigudem (above, pp. 56 ff.), one would not be disinclined to hold them as of an equivalent chronological horizon. The disappearance of the pebble tools in the subsequent phase at Karempudi might also be taken as a possible stage for the Nagarjunakonda industry as well, since in the overall quantitative scheme, the pebble tools of the valley have indeed a comparatively feeble representation. The corresponding pebble-tool group of Kurnool sites is unlikely to have followed a basically divergent pattern.

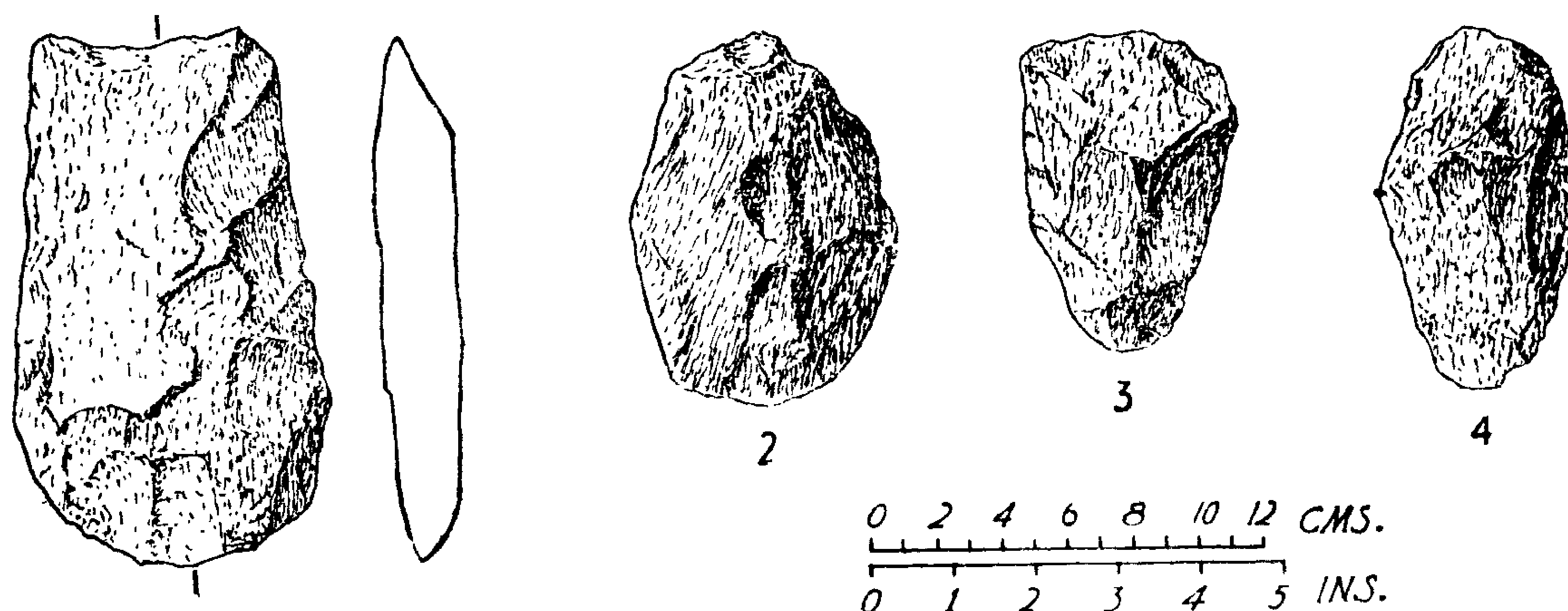


FIG. 19. *Palaeoliths from Raipur, C. Maries collection* (courtesy British Museum)

In the Karnatak area, Sankalia and Joshi did not find pebble tools in the earlier horizons,[1] but the Abbevilleo-Acheulian and Clacto-Levalloisean elements, akin to the Madras bifacial family, were all there. Further north, in the Godavari valley again, Sankalia did not find any pebble-element, and the biface-industry here was followed by one mainly of chert, agate, jasper and chalcedony and manifesting a flake-blade advancement. The prominent fact is the lack of the earliest pebble group in the Godavari basin. The Narmada-Sabarmati evidence has been mentioned above (p. 86).

The broad cultural lines on which the Lower Palaeolithic groups of the south, with special reference to the pebble tools, may tentatively be resolved may be as follows. The pebble-tool group was the earliest primitive tradition of the Lower Palaeolithic and is well-perceived in the lower south in the peninsula, and it is generally absent here beyond the Early Abbevillean-Acheulian stage. The northern limit of this feature may be the Krishna valley, which comprises Nagarjunakonda and Karempudi. Further west and north in Karnatak and the Godavari basin, for reasons not yet firmly worked out, this primitive tool-type is largely lacking in the lowest horizons of the industries, which begin, in observed areas, only with the main Abbevillean bifacial core tools of the Madras family. The Narmada and the Sabarmati valleys, on the contrary, do indeed seemingly indicate the actual existence of the pebble-tool tradition together with the northward-bound Madras biface-tradition, though the Sohan kinship of the former is as yet undetermined and may ultimately be disproved.

[1] Shri M. N. Deshpande, however, informs that he has recently noted a few pebble tools at Nandikeswar on the Malaprabha river.

The wide range of sub-types indicated in the pebble-tool element of the south, as shown at Nagarjunakonda, Karempudi and the Kurnool sites, which may seem to have broad parallels in the Early Sohan industry of the north-west, would, however, reflect largely the primitive effort involved in the two regions, which have flown out of the inescapable limitations of rudimentary techniques. While in the former region the industry had become extinct by the second stage with the coming into its own of the bifacial tradition, in the latter (Sohan) region it persisted with many developments, vitalized that it was by the dominating Levallois flake-technique. The reason for this will perhaps have to be ultimately sought for in the differing environmental and climatic conditions and probably in till-now unestablished ethnic differences too. It may even be finally established that the Levallois influence reached the Sohan valley from the immediately north-west tract, in the Soviet Central Asia, northern Afghanistan and Iran, where recent work has brought out many interesting phases of the Old Stone Age.

That it is feasible to think in terms of differing racial origins too would seem to be suggested by the fact mentioned earlier (p. 85) that while the African Kafuan and Pre-Stellenbosch pure pebble-tool facies first appear in deposits relating to the Lower Pleistocene proper, the earliest available tool-assemblages of Java on the other hand cannot be older than the Middle Pleistocene, despite the admittedly earlier occurrence of the Pithecanthropus and other primitive hominids here. Thus, a greater amount of dependable field-material and more careful study are clearly required in an intermediate region like India before we can resolve the relationship of the pebble-tool industries at various sites in terms of time and space.

5. THE MICROLITHIC INDUSTRY OF NAGARJUNAKONDA

A. General cultural elements

The microlithic industry of Nagarjunakonda, already mentioned (p. 50), is entirely made on silicious rock-material, of rather inadequate supply, and is in the main non-geometric, the predominant types being almond-shaped points, backed blades, crude lunates, side- end- and thumbnail-scrapers, perforators or awls and burins. Of these, the burins are particularly interesting and, with the clear non-geometric nature of the industry as a whole, would argue for a comparatively early date for the assemblage. The tools, but for their relative crudeness, generally compare well with the microlithic assemblage found in the Kurnool area and, outside India, with the African Wilton. The burins are of the transverse-ended *bec-de-flute* or flat-faced type. The occurrence of a nearly 2-ft. thick granular rocky gravel-wash, containing small pebbles of agate, chert, etc., and also many tools and flakes as a detrital deposit, in the lowest flats of the north-east corner of the valley close to the river and far separated from the findspots of the Upper Palaeolithic tools in the valley would seem to argue in favour of an interval of time between the two groups. On an intensive exploration and examination, the microlithic industry of Nagarjunakonda is likely to reveal many important types characteristic of the Holocene microlithic culture in this part of India.

B. The tools

A description of selected microlithic tools (fig. 20; pl. XXVII) is given below.

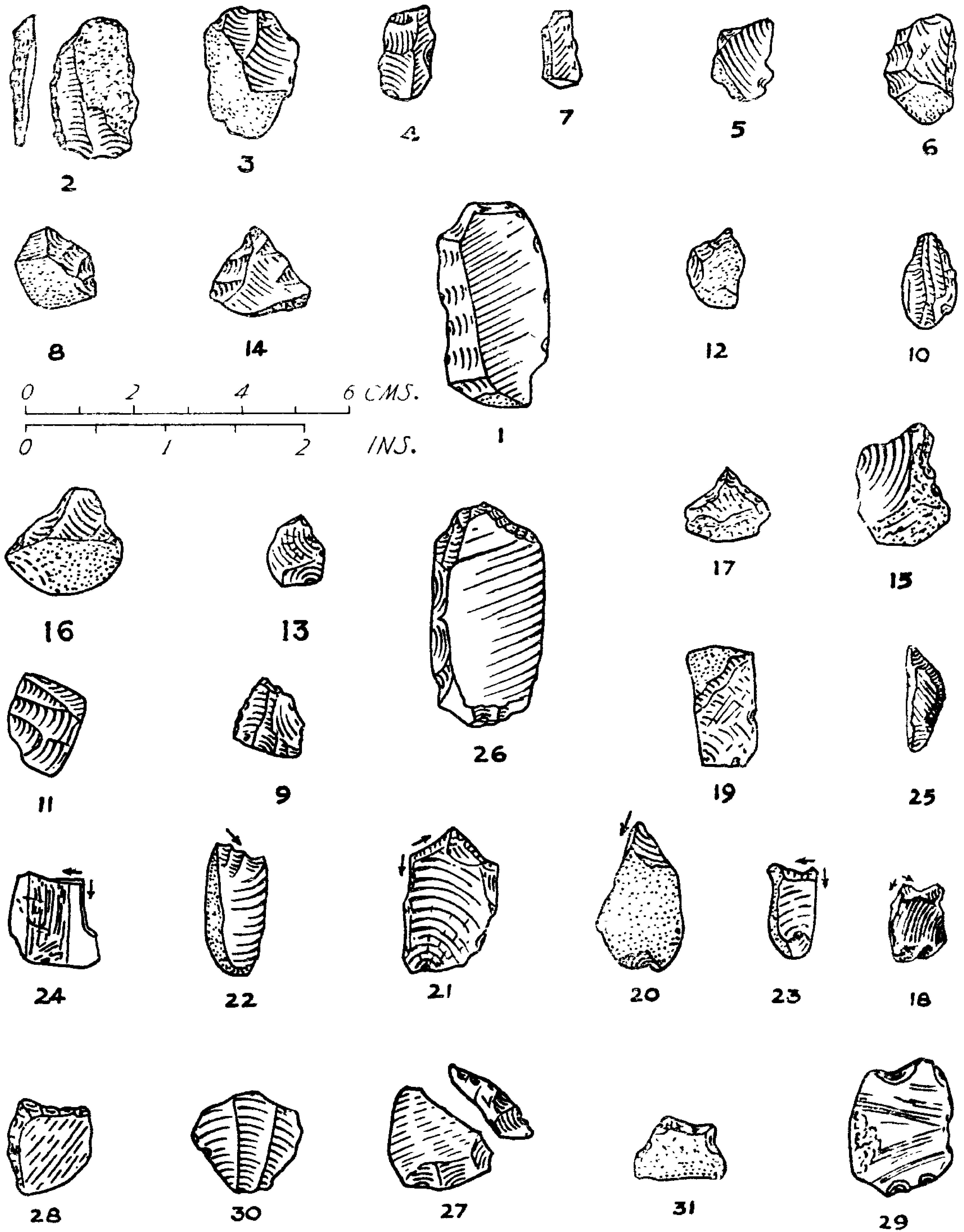


FIG. 20. *Microliths from Nagarjunakonda: 1-4, backed blades; 5-7, crescentic tools; 8-14, points; 15-18, perforators; 19, chisel; 20-24, burins; 25-31, scrapers*

(i) *Backed blades*

Nos. 1 to 4. Of the four blades which are in the descending order in size, no. 1 is on banded cherty quartzite with a steeply-blunted back and the opposite sharp edge showing signs of use. It is in a worn-out condition. No. 2, which is on an opaque cherty agate, has a steeply- and delicately-retouched curved back and a straight sharp opposite edge, which is also retouched. It is almost like a crescent and is in a fresh condition. No. 3, on transparent agate, is incomplete and has a flake-scar on the underside, with the bulb removed by secondary trimming; on the upper side the marginal edge was perhaps in course of preparation, the rest of that side bearing a cortical patch. Even in this condition, its limited upper right edge could have been employed as a knife-edge. No. 4 is a small incomplete blade on limpid agate with a side-blow scar on one side, the opposite edge showing trimming perhaps for a blade-edge, which shows, besides, serrations due perhaps to use.

(ii) *Crescentic tools*

Nos. 5 to 7. No. 5 is a single imperfect specimen of a crude crescent on banded agate, with the major part of the arc blunted and the sharp chord-edge showing retouch and serrations due to use. No. 6 is a complete specimen of a crescent on an amber-brown banded agate-flake, with the chord steeply blunted and the arc showing a fine retouch. Part of the upper surface retains a cortical patch. No. 7 is another complete, though irregular, specimen of a crescent on a pale yellow agate, with the arc blunted and chord showing signs of use.

(iii) *Points*

Nos. 8 to 14. They are small roughly triangular as well as almond-shaped points of dissimilar sizes on secondary flakes. Nos. 8 and 9 have each a major flake-scar on one side and are marginally trimmed and serrated for use on one of the other sides. Nos. 10 and 11 are bifacial points, of which no. 10 is a neat little finished but rolled specimen. No. 11 is asymmetric, with a cortical patch at the base, and is on a cherty quartzite piece. Nos. 12 to 14 are double-trimmed points, of which no. 14 is a fine triangular specimen with marginal retouches on all its three sides.

(iv) *Perforators*

Nos. 15 to 18. They are on either flakes or cores with the awl-end formed by retouch on its either side. Of these, no. 18 is distinctive in having a transverse burin-edge besides the awl-point. They are all on mottled agate-chips.

(v) *Chisel*

No. 19. Perhaps incomplete, it is made on a flake of translucent white agate and has a sharp chisel-edge, the opposite upper end retaining the cortex. One of the side-edges is also sharp.

(vi) *Burins*

Nos. 20 to 24. These are all examples of burin-edges on asymmetric flakes variously on agate and chert. Of these, no. 20, on chert, is a *bec-de-flute* burin, with one side steeply blunted and at the tip a burin-facet removed on the opposite side. No. 21, which is on cherty quartz, has one margin trimmed and delicately retouched, with a burin-spall removed across it on the sharp upper tip; it could have been a scraper-*cum*-burin. No. 22, which is on mottled smoky agate, is a simple *bec-de-flute* burin, with two intersecting steep spalls. Nos. 23 and 24 have transverse burin-edges and are on agate pieces, with trimmed transverse edges and deep vertical burin-spalls on one side.

(vii) *Scrapers*

Nos. 25 to 31. Of these, no. 26 is a fine specimen of an end-scraper on cherty quartzite, with one thinner margin untrimmed and the other thicker margin steeply backed and one of the terminal edges steeply and carefully flaked and nibbled into a delicate 'nosed' scraper or planing tool. The other end also is steeply trimmed either for a broad scraper-edge or for hafting. Nos. 27, 28 and 29 are respectively a side-scraper, end-scraper and concave scraper, variously on chert and agate (in one case banded). No. 30 is a thick steep-ended scraper on a small smoky agate pebble with a vertical retouch across the pebble-edge. No. 31 is a delightful specimen of a thumbnail-scraper on a small split pebble of coarse agate with a crescentic margin steeply retouched and nibbled for a scraper-edge. The chord-end indicates a negative scar.

6. THE NEOLITHIC INDUSTRY OF NAGARJUNAKONDA

A. Introduction

Due largely to its inaccessible and indeed forbidding nature, the jungle-clad valley of Nagarjunakonda did not attract the attention of archaeologists till the middle twenties of the present century. Even then, the Stone Age vestiges of the valley remained unnoticed, as they could not strike the eye of the uninitiated, though the valley had served as a human abode throughout the Stone Age, of which the palaeolithic and microlithic phases have been described in the foregoing pages. We shall now deal with the relics of the neolithic people—typo-technologically the distant successors to the palaeolithic savagery—who apparently introduced agriculture and an allied domestic economy. We have already a familiar picture, from elsewhere not far away, of the craftsmanship and equipment of the neolithic folk, since the lower Deccan forms the very nucleus of the neolithic culture, with Bellary and its environs as the focal centre. It is therefore all the more satisfying to observe that right across the river-belt from Bellary up to the eastern sea, there might have been neolithic settlements in Bellary, Cuddapah, Kurnool and Guntur Districts. Foote, as we know, had already a few surface-neoliths to report from the eastern part of Guntur District. As Childe pertinently observes, far from being a scattering of discrete units, the neolithic world should be viewed as a continuous chain of communities, each linked to its neighbours on either side by recurrent, if infrequent and irregular, contacts. Just outside the Nagarjunakonda valley, near a mango-grove by the road-side about four miles up on the road to Macherla, where the first neolith was picked up by Wheeler in 1944, a clearer occurrence of neoliths has been noticed recently. This, together with the great variety of the tool-types available in our limited collection which can claim clear analogues from elsewhere, would substantiate the truth of Childe's remarks.

The neolithic industry at Nagarjunakonda was located by the author in Locality F (fig. 1; p. 50) spread over a limited area of less than two acres. In the following pages is made a preliminary study of the industry, based on the representative and, to some extent, self-contained surface-collection of about fifty artefacts made by him and revealing the main types and the general character of the industry. It is followed by the results of actual trial-excavation carried out by him here.

B. Technique and typology

The outstanding tool-types represented in the collection are axes, 'shoe-last' hoes, wedges, adzes, picks or retouchers, chisels, hammers and miscellaneous flake tools. The

artefacts are invariably made on trappoid or basaltic rock which is seen exposed intermittently in the central high ground of the valley, besides other zones on the flank of the steep road leading out of the valley (fig. 3, p. 50), occurring usually in a roughly south-east to north-west strike in the form of bodies of basalt and veins of diorite. These break conveniently into oblong multi-plane nodules. A typical specimen of an almost naturally-shaped tool is represented by no. 2 (fig. 21; pl. XXIX D): it has only the bottom edges chipped secondarily for functional use. The masses to be used for the tools are, however, carefully selected and only the fine-grained basalt is generally employed for good tools. As usual, the nodules are first subjected to bold alternate flaking, which results in an irregular quadrilateral cross-section and jagged-edged periphery. Then, with the help of fabricators and picks or flakers, the high crests of the zigzag edges are straightened and particularly the cutting edge is reduced to more recurrent but subdued tiny alternate flake-scars. The tools would then be ready to be ground and polished. While grinding would have been done often by rubbing the tool against any soft rocky surface or grooves directly, the more specialized process of polishing would probably have been accomplished with the aid of separate burnishers or slick-stones applied to each tool. This polishing was either limited to the cutting edge, as in many cases, or all over the body as in the case of characteristic finished neolithic axes.[1] The classification of the tool-collection according to typology given hereunder is largely on the lines adopted by Subbarao for the Bellary neolithic industry, which would seem to fit in adequately well for many of the types exhibited at Nagarjunakonda,[2] as far as they can be outlined by the limited material. It may be mentioned in passing that of the total number of tools collected from the surface, more than twelve have an adequately polished exterior and the rest are in various stages of production. A few of the tools exhibit re-chipping as well. Of the profusion of elongated plain-platform flakes, often with secondary chipping, found scattered on the surface, as also heavy spherical basaltic cores with deep multiple scars, only a few which merit special mention have been included in the following description. Broken fragments of tools, which were also found in good numbers, have, as a rule, been left out, except those where a polished working end is available. In some of the specimens, to varying degrees, patination was

[1]Even in Bellary, Subbarao had a total of nearly four thousand flakes and cores from excavations and surface-collection, of which about forty only were finished polished specimens.

[2]Worman's classification of Indian neoliths on the basis of the 'Kultur-Kreise' approach, at least so far as the tools of the lower Deccan and South are concerned, would seem to introduce a degree of generalization in the argument. This aspect has already been rightly indicated by Lal (1953). Without seeming to enter a caveat, it may be asked why the more advanced oblong-sectioned types of group III of Worman also did not penetrate into the Deccan and South, as they should have, since human nature would have certainly welcomed fresh improved trends, especially when both the areas dealt with fall under more or less similar climatic zones.

It may, on the other hand, be readily agreed that the oblong-sectioned straight-sided and shouldered celts no doubt reached India through the north-east area, as a part and parcel of the south-east Asian wave of neolithic culture, the other aspect of which, viz. the megalithic association, is also identical in that region. But, for the southern neolithism (as typified by the pointed-butted oval celt and indeed many other elaborate devices, as suggested by true factory-sites like Sanganakallu), we have to seek either the mechanism of diffusion from some other direction or development within the area. Besides, a neolithic tool-industry—which is itself not an end-product of a neolithic economy but could have often preceded farming, etc., as shown by Childe —is in the nature of a basic evolutionary trend, in response to a regional stimulus, and for explaining its rise and spread, the ' limited-foci' concept need not invariably be invoked. At Nagarjunakonda, the pointed-butted oval axe, shoe-last celt, wedge, chisel, etc., are emphatically in evidence. In fact, the tool-equipment is an eloquent index of the general trends of cultural borrowings in which the north-east neolithic industry would seem to have played no specific rôle.

observed: but since this is hardly a reliable criterion for judging the age of the tools concerned, no such scrutiny has been made. It is opined, in general, by Worman that tools exposed to atmosphere patinate more than tools hidden underground; patination also varies with the nature of the material.

C. The tools from the surface

Type 1. Axe with elliptical or oval cross-section (fifteen specimens), worked into a pointed butt and having a convex cutting edge not infrequently straight. It is the most characteristic type of the south Indian neolithic industries and is found at many places like Brahmagiri, Bellary, Salem and Vellore and in Banda District in Uttar Pradesh in fine polished forms. Of the specimens in our collection, half a dozen are finished and one or two perhaps re-chipped and again polished. One of the less-than-medium specimens (not illustrated) has an angular oval section and slightly-splayed lower side-edges; it is incomplete. The largest tool in the collection (no. 1), more than 7 in. long, has, owing to its unfinished nature, a sub-rectangular cross-section along the upper part of the tool but has a humped lenticular section nearer the edge which, however, is convex and sharp, ready to be ground. The way the lower edge is rendered flatter would seem to make the ultimate tool as much an adze as an axe. There is another finished specimen too, no. 5, which has this asymmetric slope on either side of the edge. These and a few other smaller tools may be called axe-adzes. A broken specimen must have been larger than the largest tool mentioned above had it been intact: as it is, only the upper two-thirds are preserved, even which are nearly 6 in. long.

One of the specimens in the collection, no. 2, has a triangular cross-section and is fashioned on a more or less natural-joint planed nodule, with only the lower edge showing trimming to some extent.

Nos. 1 (fig. 21), 2 (fig. 21; pl. XXIX), 4 (fig. 21; pl. XXVIII B), 5 (fig. 21; pl. XXIX), 6 (pl. XXIX), 7 (pl. XXVIII A), 8 (pl. XXX A), 9 (fig. 21), 12 (pl. XXXI) and 28 (fig. 22; pl. XXIX).

Type 2. Axe with a flat oval or lenticular cross-section (four specimens), distinguished by a flat median area on both faces and a generally rounded butt-end and widely-curved convex cutting edge. One, no. 14, is in the first stage of chipping and is of a large size. Of the rest, one, no. 13, is relatively flatter and more regular than no. 14; both are unpolished specimens. The last, no. 15, is chipped and ground but not polished.

Nos. 13 (fig. 21; pl. XXX B), 14 (pl. XXX B), 15 (pl. XXX B) and 16 (pl. XXXI).

Type 3. Blunt-butted axe (six specimens), with a semi-triangular body, the butt-end of which is made of thick, blunted or dished plain butt as if truncated. The butt often shows battering as well. It has a well-ground and polished face and an extremely convex sharp and fresh cutting edge—that of a wedge. Of the two finished pieces, no. 21, is squattish and polished all over but for the battered butt; no. 17, damaged after use, was re-chipped and smoothened but is incomplete and thinner than the first. Another (not illustrated), made on sandstone, is made on a thick flake and has one of the sides smoothened and a flaring convex edge, the other side being damaged. There is also a specimen, no. 18, smaller and thinner than others, with a limited and rather chisel-like lower edge, which is chipped but not polished. It is as much a wedge as a cold chisel in form.

Nos. 10 (fig. 21), 17 (fig. 21; pl. XXXI), 18 (pl. XXX A), 21 (fig. 21; pl. XXXI) and 47 (fig. 21).

Type 4. Shoe-last celt (three specimens), a very specialized form of neolithic axe, so termed by Childe, presumably owing to its shape and prominent plano-convex cross-section. The upper side is of a longitudinally sweeping convex curve, and the flattish, even slightly concave, underside gently rises near the cutting edge to meet the upper side. The type is characteristic of the early agricultural communities and is a type-fossil of the Danubian neolithic culture of Europe. In India, it has been reported from Bellary, and its presence in our collection in the form of exquisitely finished and polished specimens, besides ground but not polished ones, would tend to indicate that the neolithic folk of Nagarjunakonda might have been practising

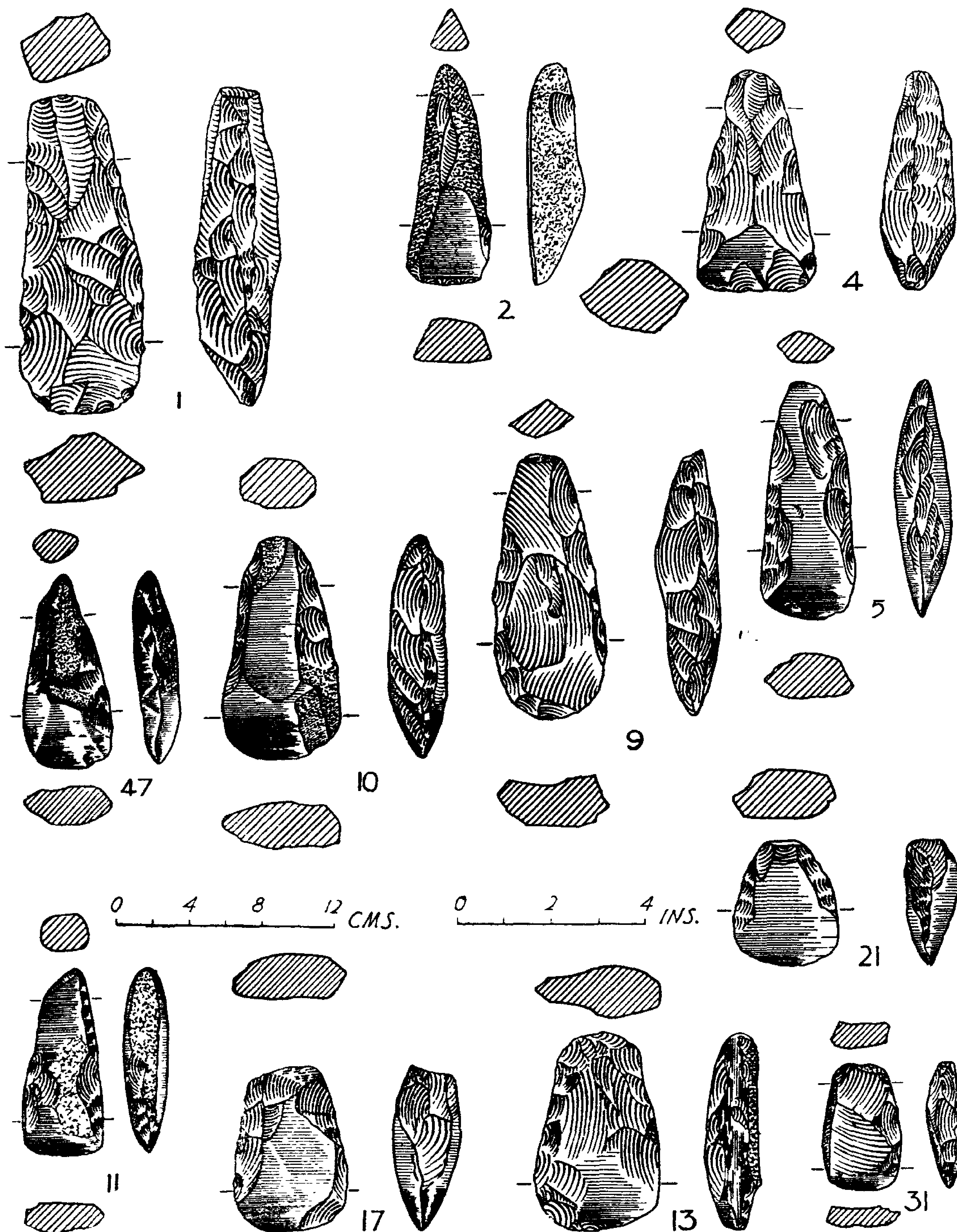


FIG. 21. *Neolithic types from Nagarjunakonda: 1, 2, 4, 5 and 9, axes of type 1; 13, axe of type 2; 10, 17, 21 and 47, axes of type 3; 11, axe of type 6; 31, celt of type 7*

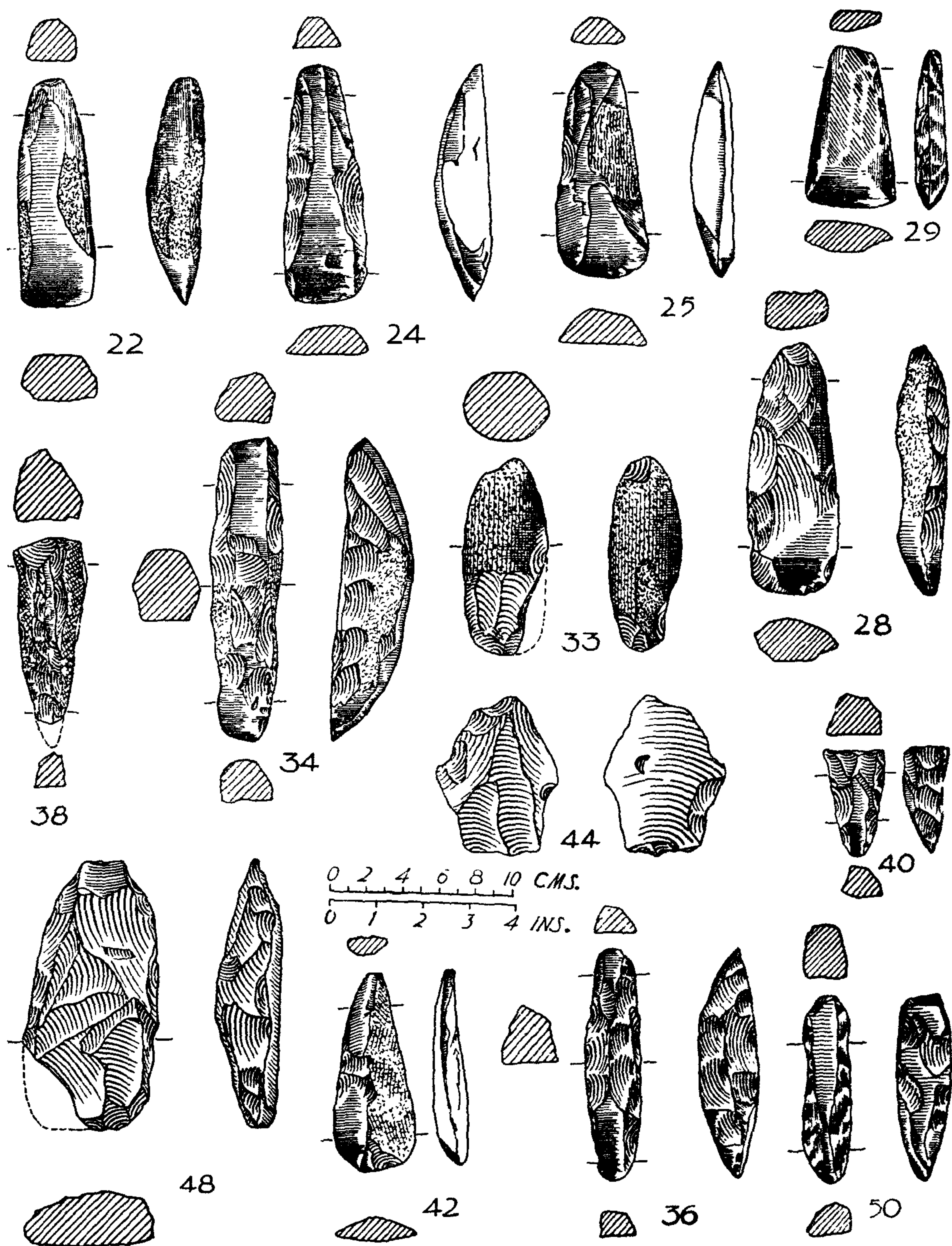


FIG. 22. *Neolithic types from Nagarjunakonda: 22 and 24, celts of type 4; 25, adze of type 5; 28, axe of type 1; 29, axe of type 6; 33, axe-hammer of type 8; 34 and 36, picks or drills of type 9; 38, 40 and 50, chisels of type 10; 42, scraping tool of type 11; 44, flake-tool of type 12; 48, celt of type 7*

cultivation: for, this tool, hafted to a stick like a golf-club, with the cutting edge kept transverse, could have been used as a hoe. Of the three extant specimens, two, nos. 22 and 24, are finished and polished and are almost text-book specimens of the type, with the side-edges slightly battered near the middle in one, due perhaps to hafting. The third one, not illustrated, has a general triangular body, more pointed butt and acutely convex cutting edge; the upper side is ground but not polished.

Nos. 22 (fig. 22; pl. XXXI) and 24 (fig. 22; pl. XXXII).

Type 5. Adze (three specimens), with a rounded working end, which is met by a steeply-bevelled and polished cutting edge from one side. The type is usually differentiated from the axe-edge type mainly by the manner of its hafting, in which it would be transverse to the haft unlike an axe-edge, which will be struck parallel to the haft. Of the three specimens of the type in our collection, one, no. 25, is finished, with a neat triangular cross-section. The other two, not illustrated, have a ground and smoothened body, re-chipped but unsmoothened edge and blunt-pointed butt; the cross-section is flattish and elliptical, and the sides show battering, indicating the hafting process.

No. 25 (fig. 22; pl. XXXII).

Type 6. Axe with semi-oblong body (three specimens), usually with a flat lenticular section, rounded butt and more or less parallel side-edge. The cutting edge is usually straight. Of the specimens, one, no. 11, is of a medium size and is polished. Of the other two, no. 30 is damaged; it is much thinner and smaller and has a high degree of polish on its working edge. The last, no. 29, is a neat, finished and extremely thin and flat celt with a trapezoidal body and sharp cutting edge.

Nos. 11 (fig. 21; pl. XXXII), 29 (fig. 22; pl. XXXII) and 30 (pl. XXXI).

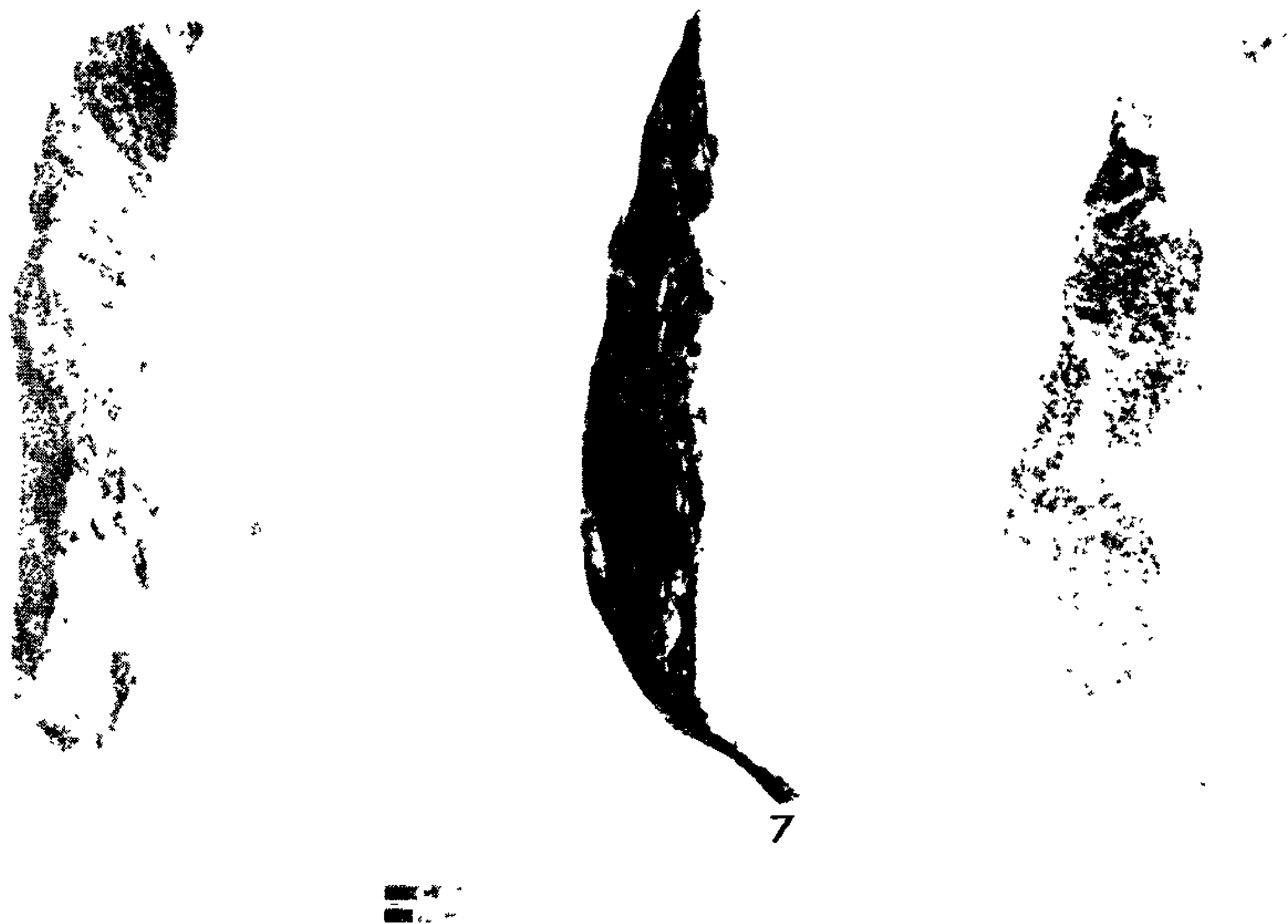
Type 7. Thin flake-celt (two specimens). One, no. 48, unfortunately damaged, is of a large size, nearly 6 in. long, and has a roughly sub-triangular body, with the upper side flatly chipped, the underside made of a flat flake-scar smoothened throughout and the edges rounded; the cross-section is thus shallow plano-convex. From its roughly parallel sides and thin section it might be looked upon as a possible precursor of similar metal specimens. The second, no. 31, the smallest tool in the collection, has a thin section, more or less semi-oblong body and polished edge, with one side showing a side blow-scar.

Nos. 31 (fig. 21; pl. XXXI) and 48 (fig. 22; pl. XXXII).

Type 8. Axe-hammer (two specimens), with a semi-triangular body, bulging oval section and convex bottom-edge. In one of the specimens, no. 33, one of the edges is damaged, but the butt and the sides and part of the broken edge show signs of battering attributable to use; as is usually the case, a blunted axe, gone out of commission, was turned into a hammer. It is ground but not polished. The second specimen, not illustrated, made of a very thick flake with a flat flake-scar underside and semi-oblong body, but both its thick upper and lower ends with battering, was probably also employed as a handy hammer.

No. 33 (fig. 22).

Type 9. Pick or drill (six specimens), an elongated tool-type with a flat base, high-ridged semi-elliptical section and convex longitudinal profile. It is got up almost entirely by chipping above, and the side-edges sometimes have notches to suit a facile grip or haft. While one end is sharp, pointed and convex, the other end has a wider adze- or chisel-like edge. The ends are usually ground and polished, except in two specimens which did not undergo the polishing operation. The specimens are of varying lengths, the largest being 6½ in. and smallest 4 in. There are two variant tools under this type: they have a rather irregular quadrilateral or triangular cross-section, and while the one end is often blunt-butted, the other end is invariably chipped to a drill-point. It is likely that the main type was useful as a kind of pick-hoe for digging out weeds, etc., while the variants were used as a drill or retoucher, which suits their shape. It may be pointed out that the former type has been recorded by Foote in the Bellary area, and a single specimen similar to this was found in the chalcolithic levels at Nevasa in central India. Further, this type would be approximately the only type that has the nearest typological affinity, if any, with the north-east Indian group by its general similarity to the bar-celts, such as those from Ban Ashuria, Mayurbhanj, etc., although the latter are much thinner and more distinctively chipped and have neat oblong sections and are, moreover, not altogether functionally related to the former.



A. *Neolith from the surface, Nagarjunakonda: type 1.* *See page 95*



B. *Neolith from the surface, Nagarjunakonda: type 1.* *See page 95*

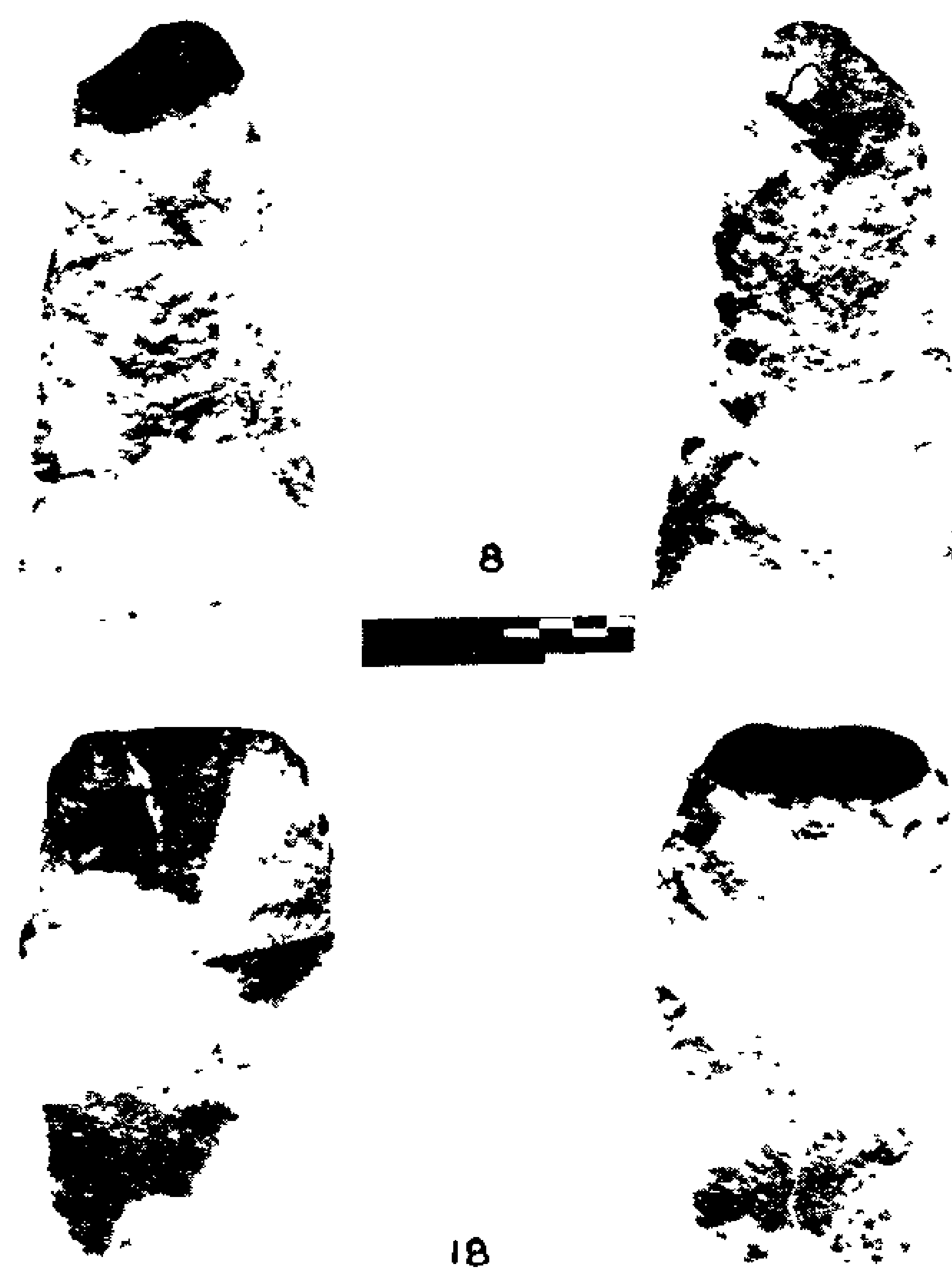
To face p. 96





Neoliths from the surface, Nagarjunakonda: type I. *See page 95*

To face pl. XXX

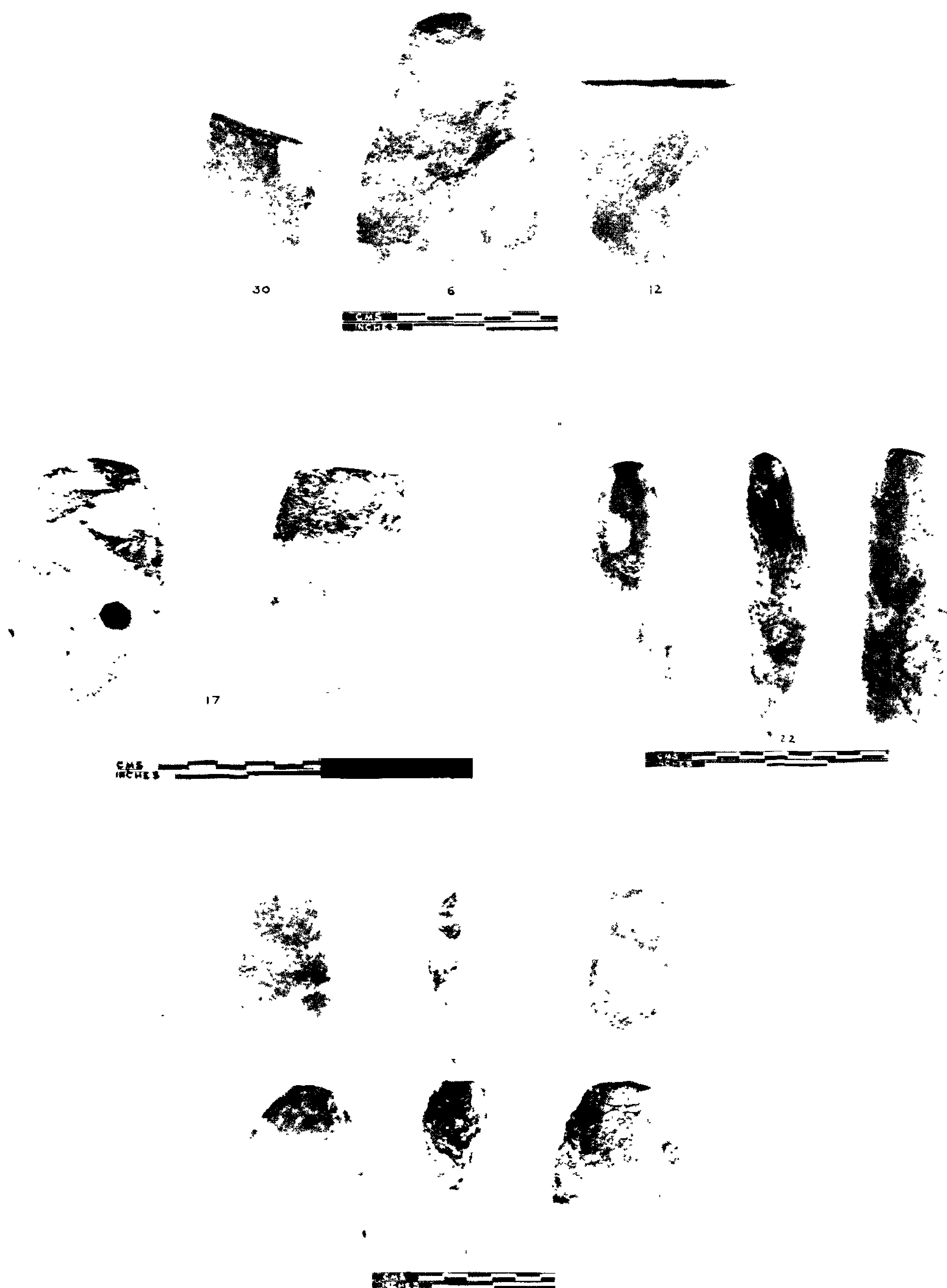


A. *Neoliths from the surface, Nagarjunakonda: 8, type 1; 18, type 3.* *See page 95*



B. *Neoliths from the surface, Nagarjunakonda: type 2.* *See page 95*

To face pl. XXIX

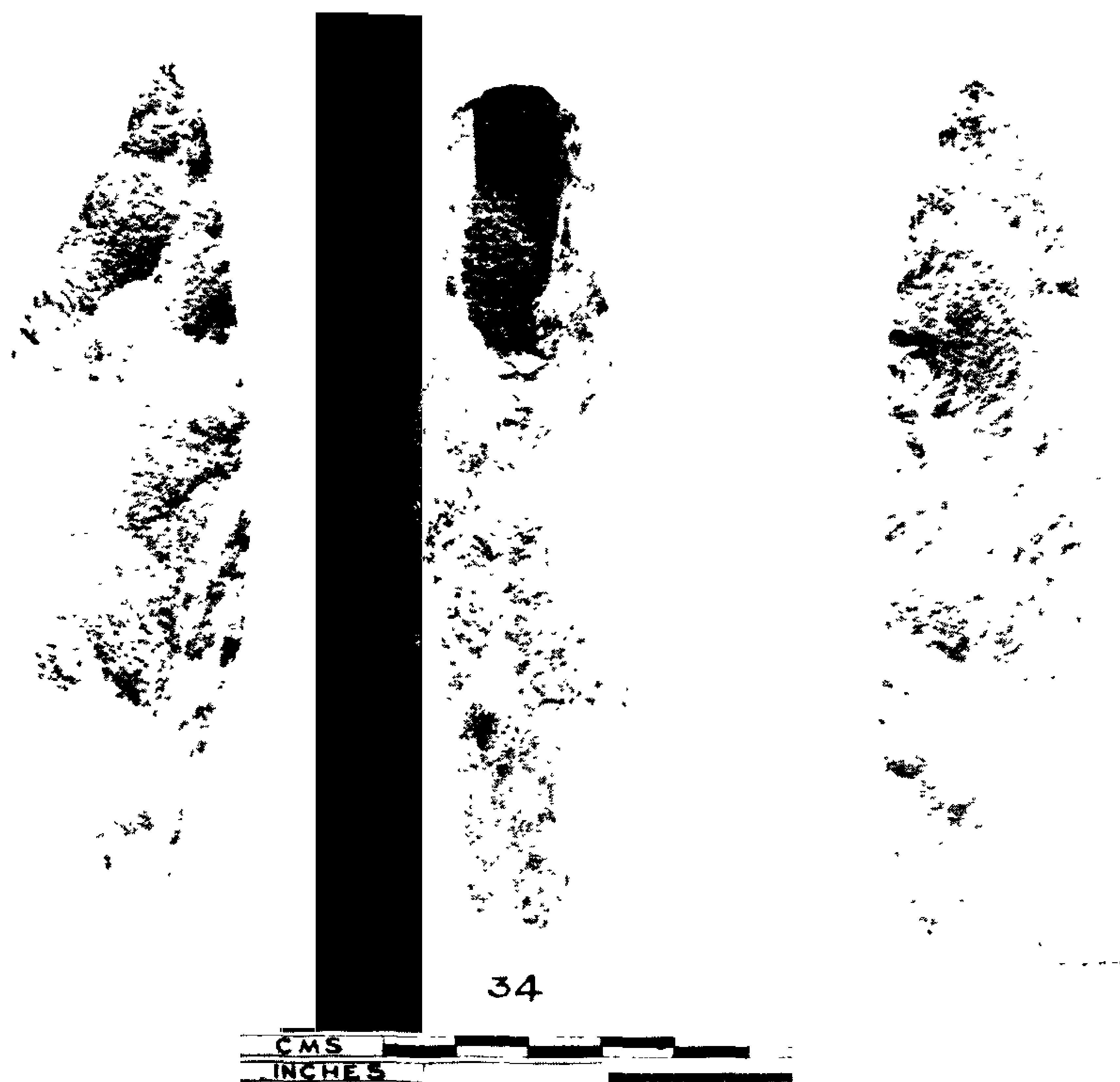


Neoliths from the surface, Nagarjunakonda: 12, type 1; 16, type 2; 17 and 21, type 3; 22, type 4; 30, type 6; 31, type 7. *See pages 95-98*





Neoliths from the surface, Nagarjunakonda: 24, type 4; 25, type 5; 11 and 29, type 6; 43, type 7. See pages 95-98



A. *Neolith from the surface, Nagarjunakonda: type 9.* *See page 98*



B. *Neolith from the surface, Nagarjunakonda: type 9.* *See pages 98 and 99*

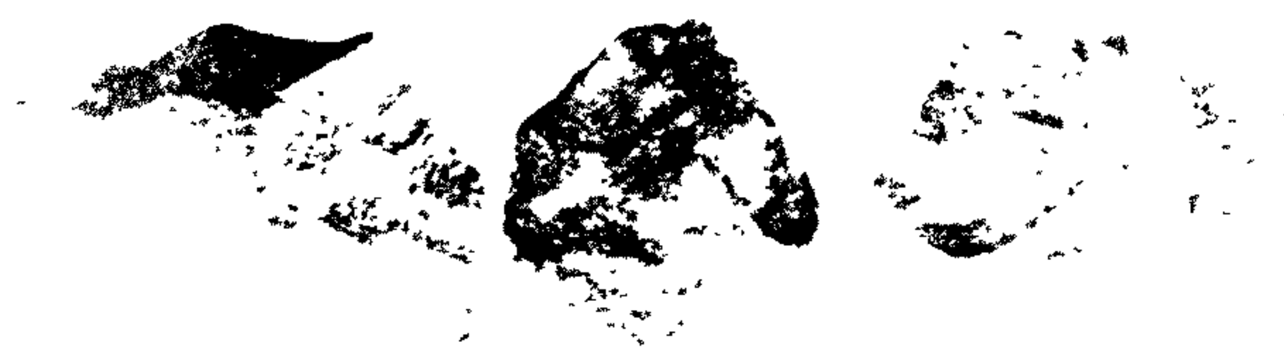
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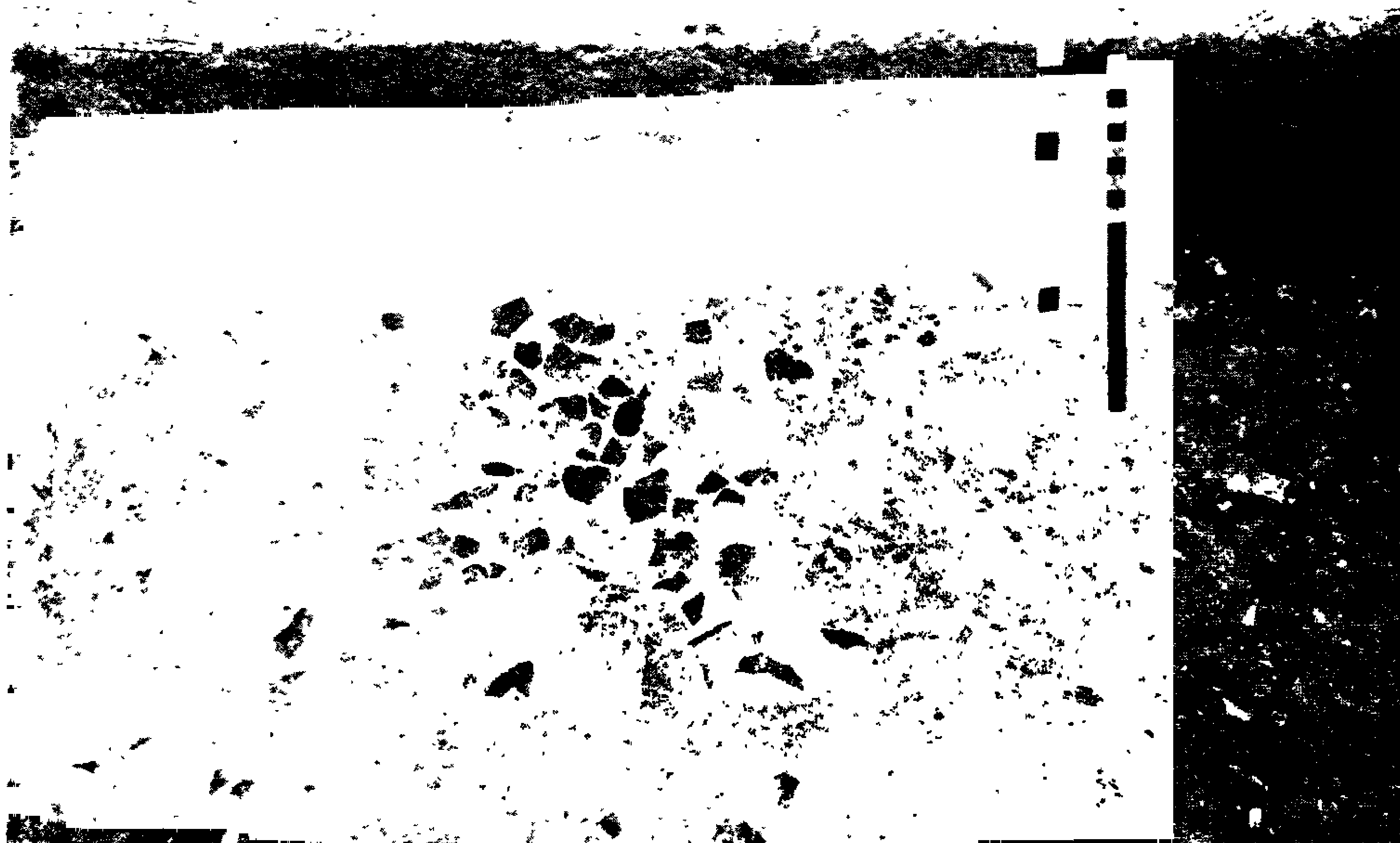






Neoliths from the surface, Nagarjunakonda: 42, type 11; 44, type 12; 45, type 13. See page 99

To face pl. XXXIII



A. *Nagarjunakonda: section of Trench C2, Division 362, showing the neolithic horizon with implements and potsherds.* *See page 101*



B. *Neoliths from the excavation, Nagarjunakonda: 1 and 15, type 1; 7 and 26, type 2; 6, type 3; 25, type 5; 23, type 6; 24, type 7; 10, 13 and 16, type 9; 11 and 12, type 10.* *See pages 102-104*

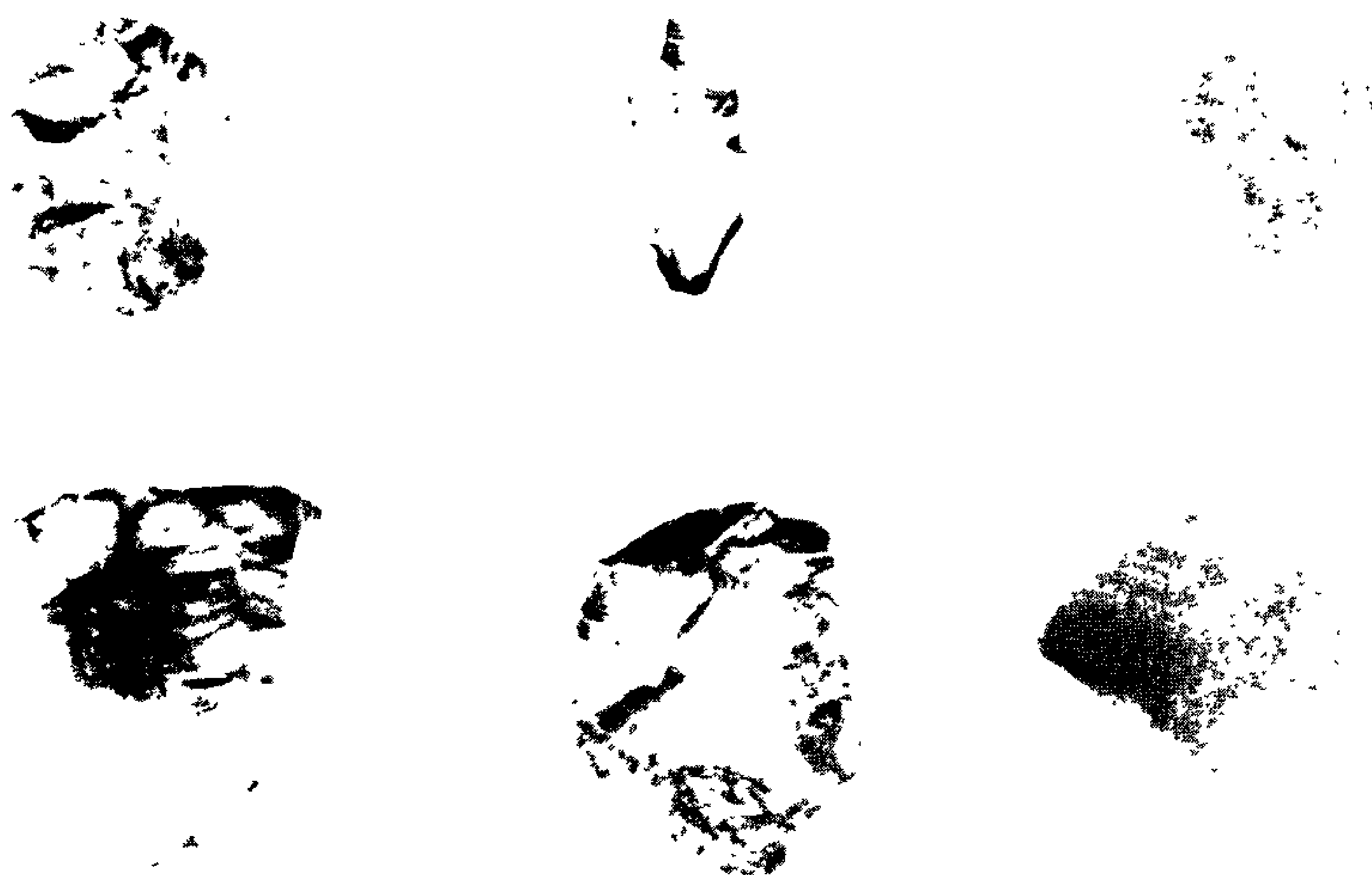


A. *Neoliths from the excavation, Nagarjunakonda: 2-4, 17, 19 and 20, type 1; 5, type 2; 8, type 6; 9 and 14, type 9; 22, type 10. See pages 102-104*



B. *Palaeoliths from the lowest levels of the excavation, Nagarjunakonda. See pages 101 and 102*

To face pl. XXXV





A. *Microliths from the upper levels of the excavation, Nagarjunakonda. See page 108*

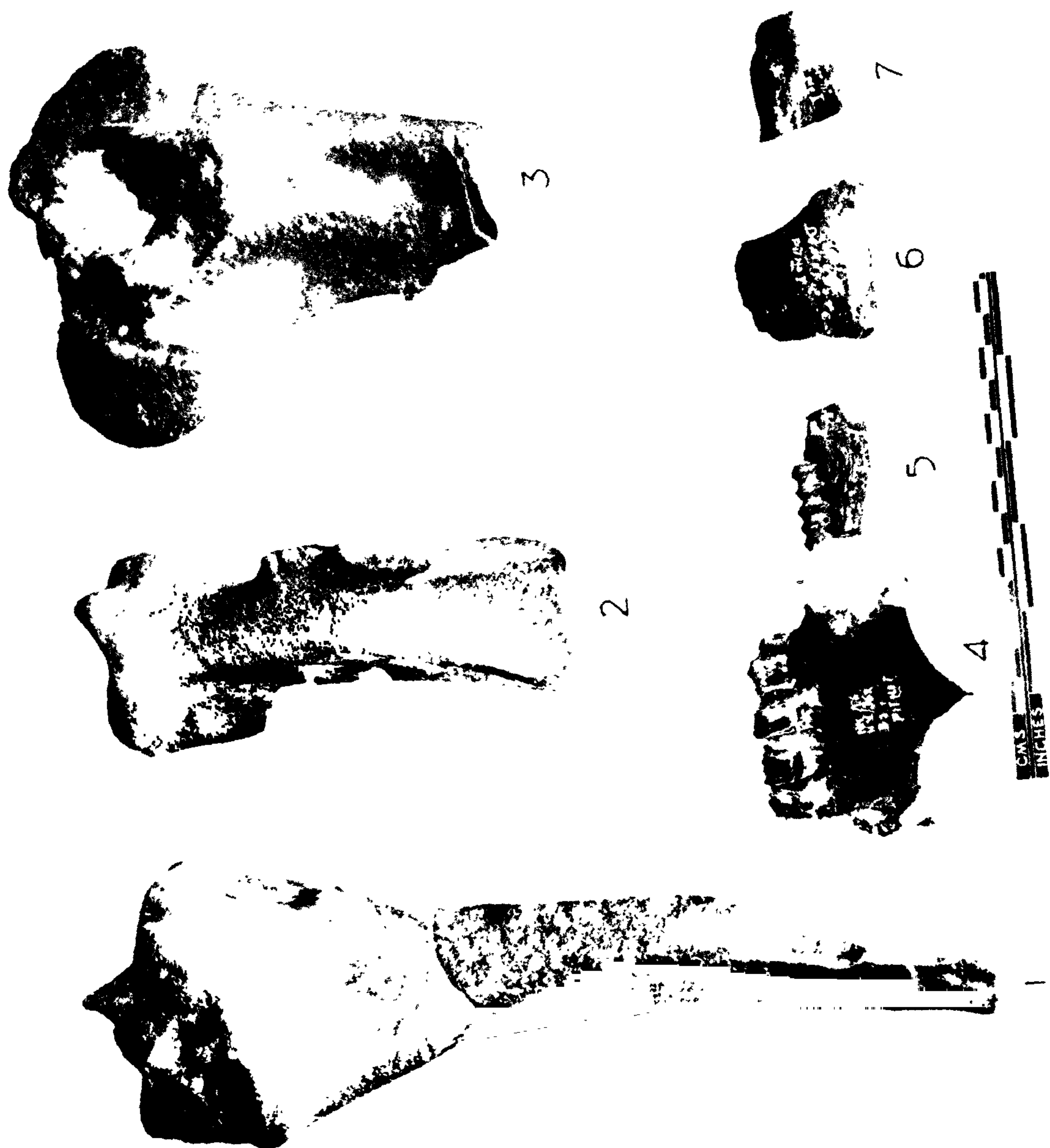






B. *Decorated potsherds from the neolithic levels of the excavation, Nagarjunakonda. See page 108*

PLATE XXXVIII



Animal bones from the neolithic levels of the excavation, Nagarjunakonda. *See page 109*

To face pl. XXXVII

Nos. 34 (fig. 22; pl. XXXIII A) and 36 (fig. 22; pl. XXXIII B).

Type 10. Chisel (three specimens). The upper part of the finished specimen, no. 40, is broken, though the typical polished, narrowing, faceted, acute-angled chisel-edge is present. The excavation has yielded a few good specimens of chisels (below, p. 104).

Nos. 38, 40 and 50 (fig. 22).

Type 11. Scraping tool (two specimens), forming a group under Foote's classification, is in general a roughly triangular tool with a thin triangular or plano-convex section and broad convex edge. The tool could be used for scraping or spade-wise. Both the specimens are thin-sectioned and have a broad convex lower edge and pointed butt. The smaller, no. 42, is of fine-grained diorite and is polished. It was found, however, as far away as near the river-bank to the south-west of the Kundellagutta hill, indicating the roaming about of the neolithic folk in the valley.

No. 42 (fig. 22; pl. XXXIV).

Type 12. Flake tool (two specimens). Both the specimens are made on broad flakes. One, no. 22, has a neat spear-head shape, achieved by surface-flaking with two deliberately-worked shoulders and a short broad rectangular tang, the terminal edge of which has been trimmed in the Levallois fashion for secure hafting. The underside has mainly a rippled flake-scar. It is likely that the tool was actually intended to be hafted to a split bamboo and used as a spear-head. It is a rather unique type, not hitherto noticed in the neolithic industries in this region. The second specimen, not illustrated, has again a flake-scar underside and a neat splayed cutting edge, which is retouched but not ground. The upper oblong body would also suggest hafting as the mode of usage; if so, the tool would serve as a flat flake-axe.

No. 44 (fig. 22; pl. XXXIV).

Type 13. Hammer-stone (two specimens). Both the specimens are of the discoidal elongated variety. There is a discoidal tool, not illustrated, which has on one side, in the middle, a small depression, suggestive of the thumbstone. There is another specimen, also not illustrated, of the oblong hammer-stone, with a rough triangular section and battered and partly broken ends.

No. 45 (pl. XXXIV).

D. General observations

From the foregoing, it would be clear that the Nagarjunakonda valley must have harboured a flourishing neolithic community, which, on the present evidence, at least of the axe-types, was familiar with some primitive mode of agriculture. From the present-day paucity of any extensive cultivable tracts in the valley—mainly due to the rocky terrain and scrub-vegetation—it can be readily presumed that the ancient neolithic community might also have felt this paucity of cultivable land and would largely have practised 'subsistence agriculture'.

E. Evidence from excavation (fig. 23)

(i) *Introduction*

The limited objective before the author in undertaking a brief excavation in Locality F (fig. 1; p. 50), where the occurrence of neolithic artefacts on the surface was suggestive, was to check whether it was feasible to locate any stratified tool-bearing horizon and also to find out if the neolithic industry had other accompanying cultural data, such as pottery, and other occupational vestiges. Within this limited framework, the excavation, it may be stated at once, proved satisfactory and rewarding, although the Locality did not turn out to be a regular neolithic factory, and this deficiency itself should now set the pace for

further search in this direction. The excavated trenches were mostly located in Divisions 362, 363, 364 and 382 of Sector NV[1], of which, however, only a row of nine trenches

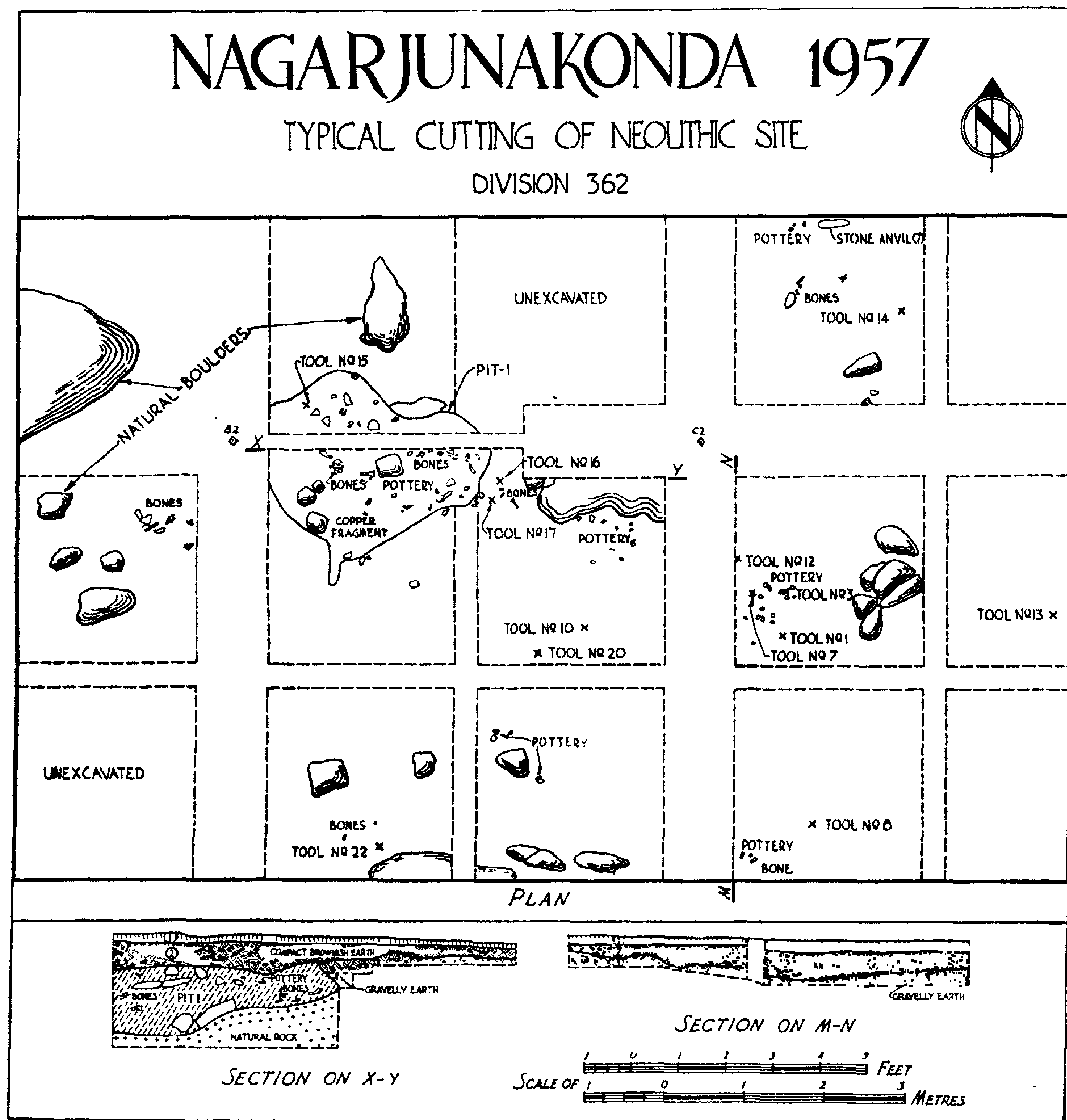


Fig. 23

[1]This is in accordance with the grid-pattern adopted for archaeological recording in the Nagarjunakonda excavations, by which each sector is an area 2000-ft. square, containing twenty Divisions, each a 100-ft. square, serially numbered, and each Division having twentyfive Trenches, each a 20-ft. square, numbered from A1 to E5.

across the first three formed a main narrow longitudinal slit, with an east-west orientation and covering a stretch of 150 ft. A few limited trenches excavated in the latter two divisions served chiefly to cross-check and supplement the general trend of the excavated evidence.

The excavation yielded as many as twentyseven neolithic tools, of which nearly three-fourths were recovered from the lowest horizon, layer 3, occurring at a depth of more than 2 ft. from the surface on an average. This layer, comprising a reddish pulverized rocky gravel, presumably a derived erosional accumulation, was overlain by a compact brownish earth, layer 2, about 1 ft. to 1 ft. 6 in. thick, and was succeeded by a loose light-brown humic earth, layer 1, about 6 in. thick. A typical section revealing stratigraphy and the concurrence of a group of tools and pottery occurred in NV-362/C2 (fig. 23; pl. XXXV A). It may be unambiguously stated that layer 3 constituted the stratum contemporary with the career of the neolithic industry. A few tools and sherds of neolithic pottery were seen to occur sporadically in the next layer, 2, also; but this may, to some extent, be due to the twin agencies of natural erosion due to rocky terrain and dry crop-cultivation, particularly since the lie of the land here has a mild gradient towards the north-east from south-west. This also explains the differential depths of cultural strata in the trenches as observed.

Layer 3 was enriched not merely by the occurrence of a majority of artefacts but also by the auxiliary evidence of pottery and bones, besides ashy deposits. In two cases, pits cut into the layer were observed. In one of them, in NV-362/B2 (fig. 23), the pit had a roughly oval shape and east-west orientation, extended over a stretch of nearly 10 ft. and attained a maximum depth of 3 ft. 6 in. A part of one of its side was lined with small boulder-fragments. Within it were seen circular pebbles, ashy and charred earth in bands and many bones, largely animal, quite a few interesting pottery-types and even conch-cores. Along the fringe of this pit were encountered two very small fragments of copper also. Tool no. 15 (pl. XXXV B) was found resting on the edge of this pit on its northern side. The pit in NV-382/B2 was cut steeply in between natural boulders and filled up with heavy ashy material over an area of nearly 10 sq. ft., down to a depth of 1 ft. 3 in., and was sealed by a blackish compact earth, layer 2 A. In this were seen potsherds and an implement (no. 25: fig. 24; pl. XXXV B). No pottery, was, however, recovered in this case from the ashy deposit itself. It would appear to be an accumulation of burnt organic refuse thrown away from hearths, etc. In this very trench, lying well into the lowest gravelly layer 3, was found a collapsed utensil of coarse thick red ware (no. 1: fig. 25) belonging to a typical neolithic shape.

An interesting sidelight was thrown in some of the trenches, largely in NV-364/A2 and /A3 but also in NV-363/A2 and NV-362/B2, by the occurrence of some palaeolithic tools and flakes, mainly on the rocky floor and layer 3 and a few in the succeeding layers also. In all, thirteen palaeolithic tools and flakes were recovered from the excavation, eleven of them, in three different groups in NV-364/A2, NV-364/A3 and NV-362/B2 respectively, from layer 3, i.e. the main lowest neolithic stratum, and two from the next layer, 2. They were mostly made on reddish-brown metamorphosed sandstone, invariably weathered heavily due to their sub-humic setting. Leaving aside even the two specimens from the upper layer, the rest form a clearly mixed assemblage, quite apart from their manifestly-derived nature in the neolithic horizon. Of the group of six in Trench NV-364/A2, in the ascending order of levels in layer 3, were seen a Levallois flake and a thick Clacton flake, and then two large Clacton flakes and two Early Acheulian bifaces. In another trench, NV-363/A2, layer 3 gave an incomplete Early Acheulian flake-made biface and a heavy pebble-butted scraper in the same ascending order. In the third

trench, NV-362/B2, among the three tools recovered in layer 3 were a unifacial pebble tool, a large plain Clacton flake and a clumsy-looking Early Abbevillean biface. A representative group of these palaeoliths is illustrated on pl. XXXVI B.

The palaeoliths cannot be utilized as sure technological indices of their respective levels. Notwithstanding this, their occurrence at such a depth in this area, even as scattered finds in the older horizons, would help us to view in aggregate the broad industrial stage represented by them at this spot. As a group, they have a convincing typological Early Abbevillean to Early-Middle Acheulian affinity, and this, from what we have seen of the main palaeolithic localities of the valley and the nearness of this site to the nullah (above, p. 53) and Locality C, is as it should be. It may also be mentioned in passing that the Levallois flake was physically the least weathered, but, unlike others, was made of fine creamy quartzite.

(ii) *Neoliths*

Quite a few of the excavated neoliths have a patinated surface ranging from a fine creamy to frosted greenish-grey texture. As already mentioned (above, p. 95), the degree of patination has not been adopted as a means of fixing the relative age of the tools. The variety displayed in them is interesting, and tools in many stages of fabrication have also been observed. Axes, picks and chisels predominate, and of these mention may be made specifically of a splayed axe with trapezoidal section and splayed ends, made on sandstone (no. 7: fig. 24; pl. XXXV B), a fine long cold chisel with a neatly polished body and working edge and blunt butt (no. 11: fig. 24; pl. XXXV B), a pointed-ended pick-drill with a semi-elliptical section (no. 10: fig. 24, pl. XXXV B) and a pointed-butted oval-sectioned axe with polished convex cutting edge (no. 6: fig. 24, pl. XXXV B), all found in layer 3 in their respective trenches.

The following is a description of the neolithic tools obtained from the excavated trenches.

No. 1. Pointed butted axe of oval section and of triangular form, with a polished straight cutting edge. Type 1. From layer 3 of NV-363/A2. Fig. 24; pl. XXXV B.

No. 2. Of the same type as above, but only chipped and not polished. Type 1. From the same trench and layer as above. Fig. 24; pl. XXXVI A.

No. 3. Pointed-butted axe, unground and unpolished, with convex cutting edge. Type 1. From layer 3 of NV-362/C2. Fig. 24; pl. XXXVI A.

No. 4. Axe-adze (basically of the axe class), which seems to have been re-chipped also, for repeated use. Type 1. From the same trench and layer as above. Fig. 24; pl. XXXVI A.

No. 5. Axe of flat lenticular section, ground and subsequently re-chipped. It has a rounded butt. Type 2. From the same trench and layer as above. Pl. XXXVI A.

No. 6. Blunt-butted axe, of more than medium size, with a polished and convex cutting edge. Type 3. From the same layer and trench as above. Fig. 24; pl. XXXV B.

No. 7. Axe, with splayed and convex cutting edge, on metamorphosed quartzite of triangular body and trapezoidal section. It anticipates the metal prototypes of subsequent times. Type 2. From the same layer and trench as above. Fig. 24; pl. XXXV B.

No. 8. Axe of semi-oblong body, of which only the upper half is extant. Type 6. From layer 3 of NV-362/D2. Pl. XXXVI A.

No. 9. Pick-*cum*-hoe, on a naturally joint-planed nodule, which is incompletely chipped along the edges. Type 9. From the same layer and trench as above. Pl. XXXVI A.

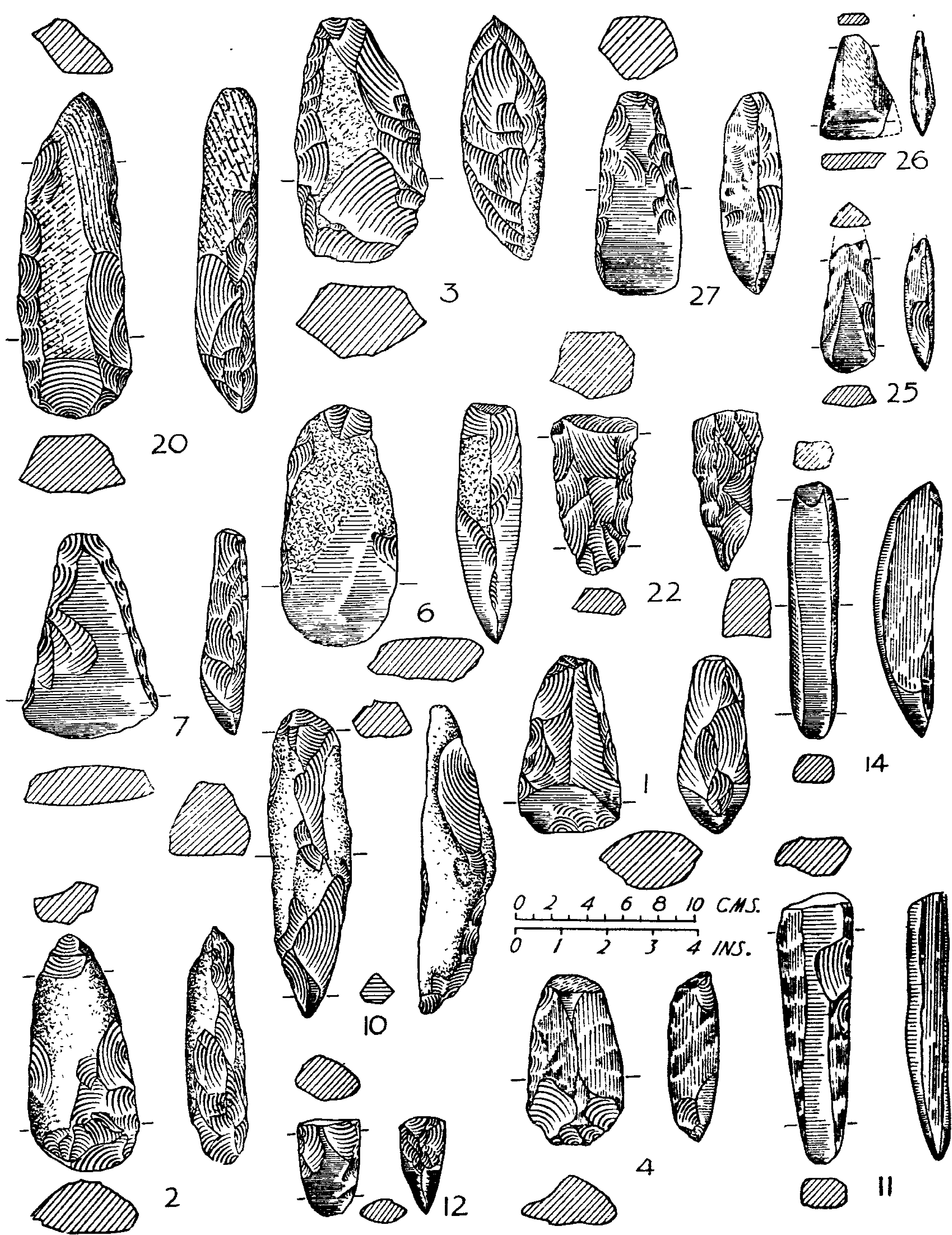


FIG. 24. *Neoliths from the excavation at Nagarjunakonda*

No. 10. Similar to the above, but has a finished, pointed and polished tip. Type 9. From layer 3 of NV-362/B2. Fig. 24; pl. XXXV B.

No. 11. Chisel, elongated and flattish. A finished and polished specimen. Type 10. From layer 3 of NV-362/E2. Fig. 24; pl. XXXV B.

No. 12. Chisel, with a fine, polished and tongue-shaped working end. The upper part of the tool, however, is broken and missing. Type 10. From layer 3 of NV-362/C2. Fig. 24; pl. XXXV B.

No. 13. Pick-*cum*-chisel. A finished, polished specimen, with twin 'axe-edge' working ends, flat base, arched longitudinal profile and high trapezoidal section. Type 9. From layer 3 of NV-362/C2. Pl. XXXV B.

No. 14. Pick-*cum*-hoe of a unique type, with a sub-triangular cross-section and a longitudinally bent body; two of the three faces chipped and the third, presumably the bottom face, smoothened. It has a pointed, pick-like tip on one end and a limited cutting edge on the opposite end. Probably hafted in the middle at right angles and used as pick-*cum*-axe. Type 9. From layer 3 of NV-362/C1. Fig. 24; pl. XXXVI A.

No. 15. Pointed-butted axe, of triangular form and straight cutting edge, which only is polished. Type 1. From pit 1 cut into layer 3 of NV-362/B1. Pl. XXXV B.

No. 16. Short specimen of pick-*cum*-chisel, broken, with semi-elliptical section and fully polished body. Type 9. From layer 3 of NV-362/B2. Pl. XXXV B.

No. 17. Axe, chipped but not ground, with a rounded butt-end and convex cutting edge. Type 1. From layer 3 of NV-362/B2. Pl. XXXVI A.

No. 18. Chisel, with a flattish base, semi-elliptical section and blunted butt-end. Type 10. From layer 2A of NV-382/B2. Not illustrated.

No. 19. 'Axe-adze', elongated with a chipped but not ground butt-end and convex cutting edge. Type 1. From the bottom level of layer 2 of NV-382/EA. Pl. XXXVI A.

No. 20. Same type as above, with a flat underside, and probably broken upper surface. It is polished. Type 1. From layer 2 of NV-362/B2. Fig. 24; pl. XXXVI A.

No. 21. Pointed-butted axe, unpolished and with convex cutting edge. Type 1. From layer 2 of NV-363/A2. Not illustrated.

No. 22. Chisel, chipped but not ground and polished, with a tongue-shaped end. Type 10. From layer 2 of NV-362/B2. Fig. 24; pl. XXXVI A.

No. 23. Axe with sub-oblong body, unpolished and partially broken. Type 6. From the uppermost layer of NV-363/C2. Pl. XXXV B.

No. 24. Thin flake-made celt with unpolished body. Type 7. From the uppermost layer of NV-382/B2. Pl. XXXV B.

No. 25. Adze, made on narrow oblong flake, with semi-elliptical section and polished on both faces of the lower part. The butt-end is broken. Type 5. From the uppermost layer of NV-362/D2. Fig. 24; pl. XXXV B.

No. 26. Axe with symmetrical flat triangular body, thin highly acute-angled, straight cutting edge, chamfered margins, vertical and ground side-edges and thinning top-end. Type 2. From the uppermost layer of NV-382/E4. Fig. 24; pl. XXXV B.

No. 27. Axe, with oval section, slightly blunted butt, polished body and straight edge. The side-margins are worn. Type 6. From the uppermost layer of NV-382/D4. Fig. 24.

(iii) *The pottery*

The excavated pottery has all the general traits of the neolithic pottery familiar to us from other sites in the lower Deccan, such as Brahmagiri, Sanganakallu, etc.: it has a thick greyish or alternately brownish colour, occasionally with a burnished exterior, and

is often coarse and hand-made. Greyish and brownish wares are found in more or less equal proportions, though the latter has a greater variety of forms. Grooves on ledges and incised herring-bone patterns appear as a common decoration. Except a single sherd (not illustrated) with irregular streaks of brownish red on the grey fabric, painted sherds are absent. Of the utilitarian types may be mentioned a fragment of a lipped pot and two spout-fragments, one in fragile and coarse brownish texture from layer 3 of NV-363/B2 and the other in the characteristic greyish fabric with burnished surface and with beaded rim, from layer 2 of NV-363/D2. It may be mentioned here that spouts form a popular device in the neolithic pottery. The outstanding pottery-type is that with a widely flaring featureless rim, thickening down towards the neck and shoulder, which is often externally ledged or ribbed, and a globular body. The thickness of the wares varies: generally speaking, specimens of thinner fabric are commoner in the greyish ware. One of the types in this group is that of a hand-made straight-sided deep bowl, of coarse fabric but burnished, with a slightly inturned featureless rim, sometimes evincing slight variations in the rim-form. It has its analogues at Brahmagiri.

The selected pottery-types are described below.

Types 1-14 (figs. 25 and 26)

Type 1. Pot of pale-red ware, with a flaring featureless rim, concave neck widening to a prominently, though crudely, ribbed shoulder and a bulging spheroidal body. Of coarse hand-made fabric and irregular thickness and indifferently fired, it has a pale-red slip. A characteristic neolithic pot-urn type. From pit 2 cut into layer 3. *Variant 1a*, of similar fabric, differs from the arch-type mainly in the distinctive high neck and rather less blunt rim. From layer 2. *Variant 1b* has a thinner though blunt featureless rim, thickening towards the neck, and is better fired. From layer 2. *Variant 1c* has a narrower neck and an externally obliquely chamfered rim and weakly ribbed shoulder. It is of ochreous red fabric. From layer 3. *Variant 1d* is similar to the preceding but is of coarse pale-grey ware fabric with a gritty core and semi-burnished look. From pit 2 cut into layer 3. *Variant 1e* is similar to Variant 1c but is larger and of thicker and coarser fabric and proportions and is treated with reddish brown slip. From layer 2.

Type 2. Typical pale-grey pot with a distinctive externally obliquely cut rim and prominent neck. Though of coarse fabric and apparently hand-made, it has a semi-burnished exterior. From pit 2 cut into layer 3. *Variant 2a* is characterized by a clubbed and pointed rim and coarser fabric. From pit 1 cut into layer 3. *Variant 2b* is a fine specimen of slipped and burnished dark-grey ware, with a more prominent top ridge and clubbing of the rim and weakly corrugated neck. From the same pit.

Type 3. Pale-grey ware fragment with a flaring externally square-cut and elliptically collared rim. It has a coarse texture. From pit 1 cut into layer 3.

Type 4. Pale-grey ware pot with a closing and flanged rim and a weak groove above the shoulder. It is of medium fabric and fairly evenly fired. From layer 2.

Type 5. Pale greyish-brown ware pot, with out-turned and externally obliquely cut rim, weakly grooved shoulder and steep profile. Of medium, though gritty, fabric and thin section, it has a semi-burnished exterior. From pit 2 cut into layer 3. *Variant 5a* is a thin coarse reddish-brown fragment with an out-turned and externally cut rim and steep profile. From layer 2.

Type 6. Unique vase or mug of pale-greyish ware, with incurved thickened and sharpened rim, irregular-sectioned body and heavy flat base. Indifferently potted, but treated with a pale red slip. From pit 2 cut into layer 3.

Type 7. Lid of pale-grey ware with an everted and internally thickened rim and shallow convex base. Of coarse fabric. From pit 1 cut into layer 3. *Variant 7a*, of dark greyish ware, differs from the arch-type in its thinner section, internally chamfered rim and shallower base. Of coarse fabric, it has a semi-burnished exterior. From pit 1 cut into layer 3.

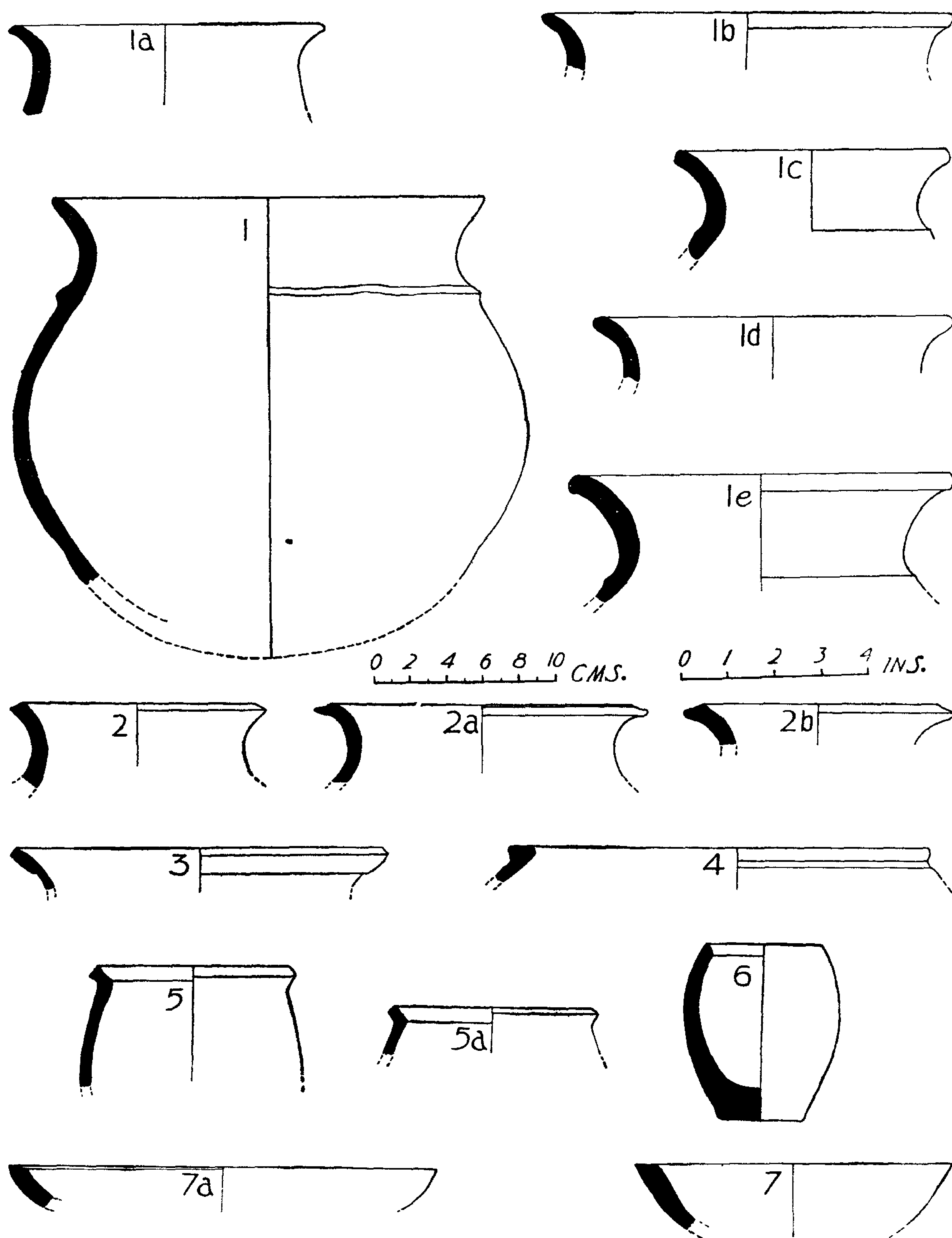


FIG. 25. *Neolithic pottery-types from the excavation at Nagarjunakonda*

Type 8. Lid of pale grey ware with sharpened and externally obliquely cut rim and tapering conical body. Of coarse fabric. From pit 1 cut into layer 3.

Type 9. Deep bowl of pale-grey ware with an incurved featureless rim and globular body. Of coarse fabric, it has a semi-burnished exterior. From pit 2 cut into layer 3. *Variant 9a,* of pale grey ware, differs only in the more sharpened rim. Of medium fabric, it has a more burnished appearance than the arch-type. From pit 1 cut into layer 3. *Variant 9b* is a dull-red ware fragment with a more blunted and straight rim. Of coarse fabric. From layer 2. *Variant 9c,* of pale-brown coarse ware with smoky patches, has a sharpened straight rim and receding profile. From layer 2. *Variant 9d* has a distinctive inturned featureless rim and a more globular body. Of pale-grey ware and medium fabric, it is polished on the exterior. From pit 1 cut into layer 3.

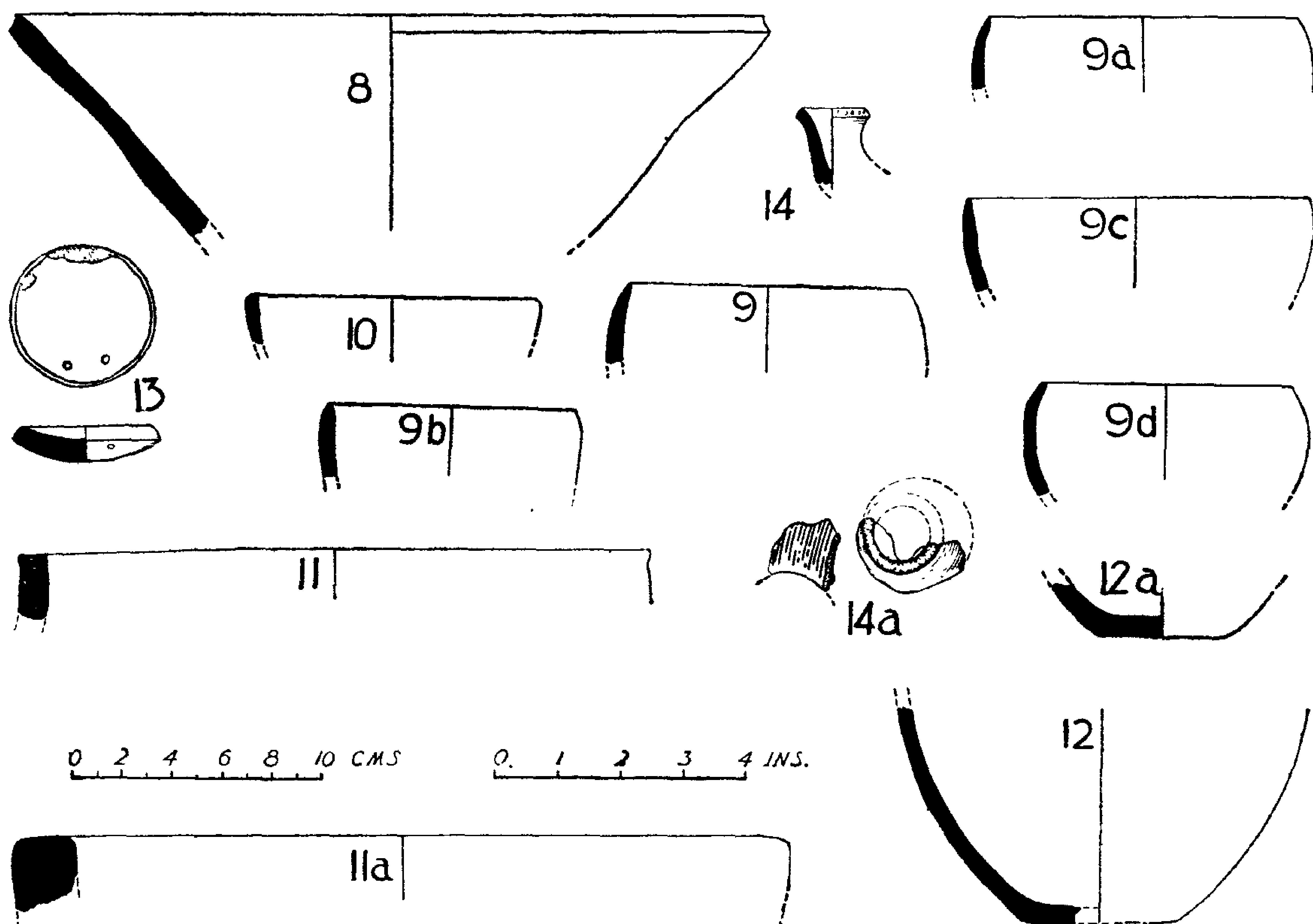


FIG. 26. *Neolithic pottery-types from the excavation at Nagarjunakonda*

Type 10. Pale-brown ware bowl-fragment with a slightly incurved and externally bevelled rim and straight body. Of dull medium fabric, it is unslipped. From layer 2.

Type 11. Thick coarse reddish-brown ware trough-fragment, with a flattened and slightly thickened rim and straight profile. From layer 2. *Variant 11a* is of thicker and larger proportions and much coarser texture. From the same layer.

Type 12. Body-fragment of pale-grey ware with smoky patches, having an elliptical body and flattened base. Of thin coarse fabric, it is treated with a pale-grey wash. From pit 1 cut into layer 3. *Variant 12a* is a base-fragment of pale reddish-brown unslipped fabric and has a thicker and wider layer profile and irregular flattened base. From pit 1 cut into layer 3.

Type 13. Diminutive lid (?) of coarse fabric, with an externally cut rim and shallow body and limited flat base. It has two perforations on the sloping sides, the purpose of which is indeterminate. From pit 1 cut into layer 3.[1]

Type 14. Short spout of pale-grey ware, with an externally cut and incised spout rim and conical spout mouth. Of medium fabric, it has a burnished exterior. From layer 2. *Variant 14a,* of coarse reddish brown ware, is slightly bigger in size and has a wider opening. From layer 3.

Decorated pottery (fig. 27; pl. XXXVII B)

No. 1. Shoulder-fragment of coarse reddish-brown ware pot with incised herring-bone pattern under double grooves. From layer 3.

No. 2. Shoulder-fragment of a coarse reddish-brown ware pot with irregular vertical incised slashes on the ribbed shoulder. From layer 2.

No. 3. Shoulder-fragment of coarse pale-brown ware with short oblique incised slashes on the ribbed shoulder. From layer 2.

No. 4. Body-fragment of pale-greyish red ware with numerous oblique streaks in black executed over the reddish brown-slipped body. The design is not apparent. From pit 2 cut into layer 3. Not illustrated.

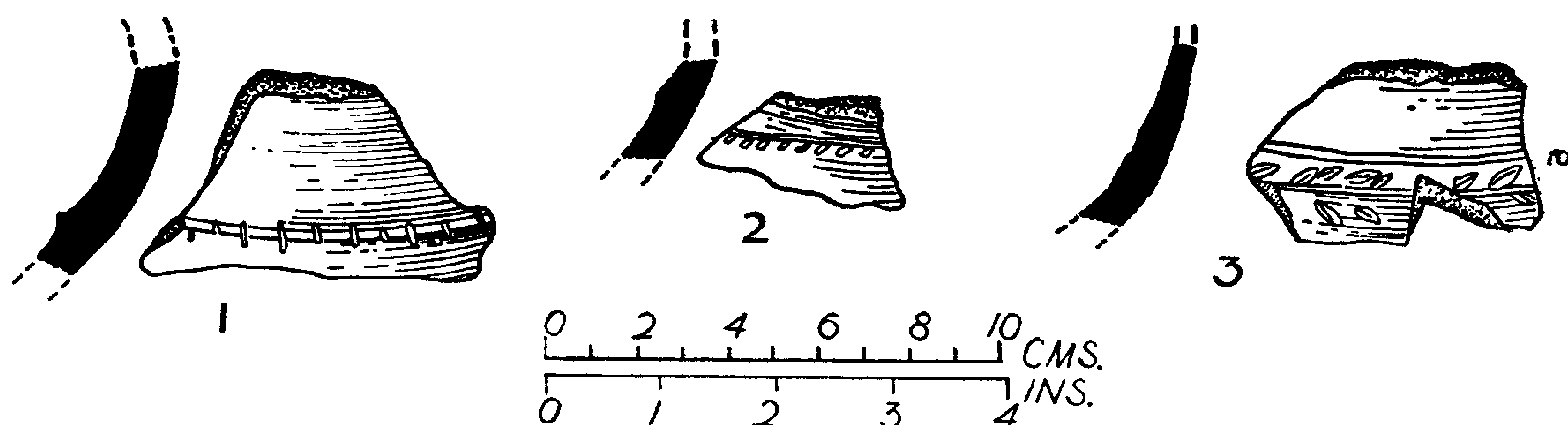


FIG. 27. *Neolithic decorated pottery from the excavation at Nagarjunakonda*

(iv) *Microliths*

It is interesting to note that a few irregular chert and agate core-fragments, including a fine agate fluted core and a few worked bladelets (fig. 28; pl. XXXVII A), occurred in the uppermost layer of NV-382/E4. These tools are later than the Epi-Palaeolithic microlithic industry from the north-east corner of the valley reported above (pp. 90-93). The fluted core particularly will fit well, on existing analogies, into the neolithic industry, though its stratigraphic association with the neoliths has yet to be proved.

The microliths are described below.

Fig 28; pl. XXXVII A

No. 1. Flattened fluted short blade-core on smoky banded agate with a thin cortical patch at the bottom-end.

No. 2. Thin-back cortexed core-lump of agate with parallel blade-trimmed negative scars on the upper side.

[1]Perforated vessels are a feature of neolithic pottery and occur at Sanganakallu and Brahmagiri.

No. 3. Thick cortexed flake of agate with incomplete marginal trimming.

No. 4. Nice small bladelet (*lamelles*) on crystal with mid-rib and serrated pointed end on upper side and flake-scar on the underside.

No. 5. Irregular lump of banded agate with a geode in it, exhibiting partial ribbon-trimming on one side. Perhaps discarded as unsuitable.

No. 6. Small nosed flake-scraper of mottled chert, with very steep careful retouch on its periphery—perhaps to serve as a scraper.

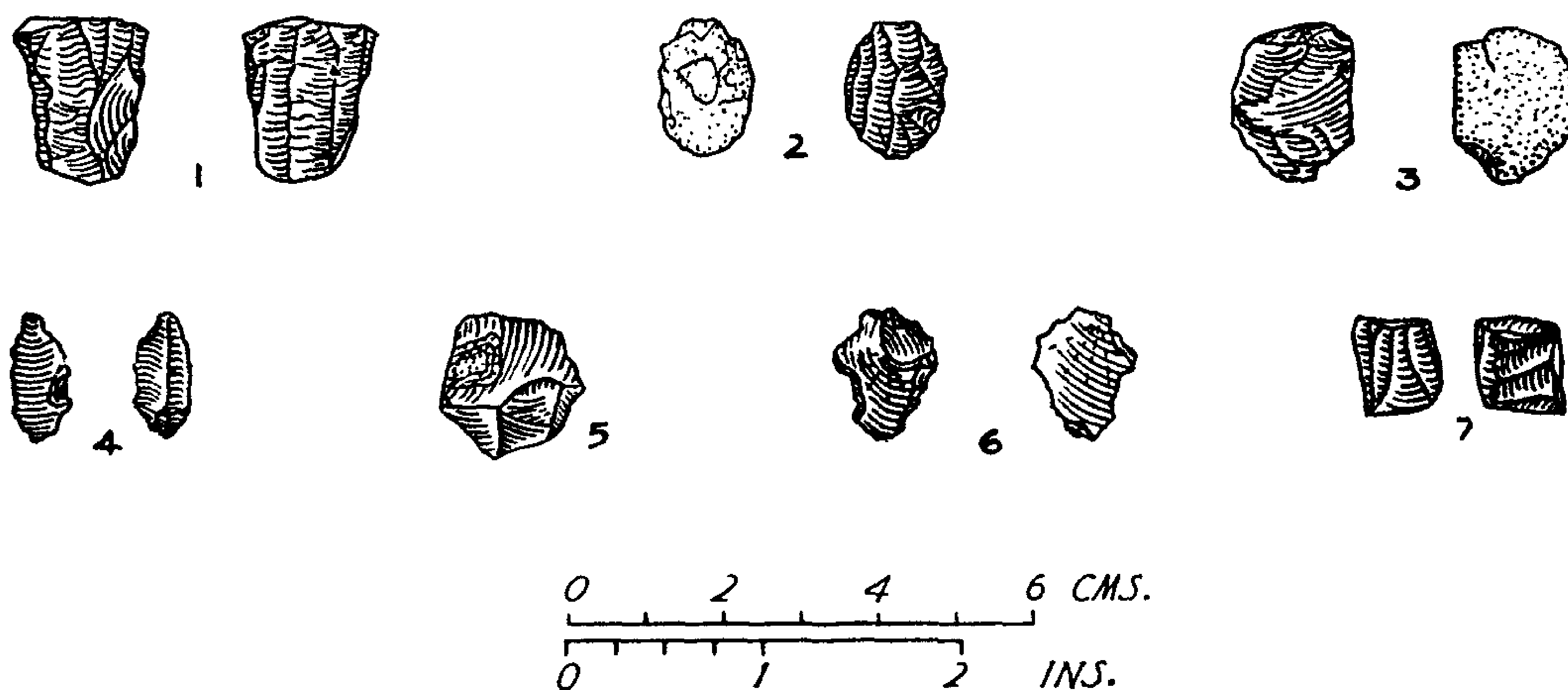


FIG. 28. *Microliths from the excavation at Nagarjunakonda*

Allied to this later microlithic industry was an excellent specimen of an attenuated short-blade fluted core on crystal (no. 7) from Sector SII near river Krishna, showing the cross-flaking technique. It is typical of the short-blade cores accompanying neolithic industries as at Sanganakallu, Nagaldinne, etc.

(v) *Animal-bones*

The bone-fragments from the excavation were invariably found in association with the collapsed remains of pottery and in one case came from an ashy pit in trench 2 of NV-362. They were mostly animal-bones, including large-sized joints and teeth, but a few human and bird-bones were also noticed. No occurrence of human bones inside pots was met with. It is interesting to note that the examination of a select number of animal-bones has revealed the prevalence of domesticated buffalo and spotted deer during the neolithic period.

Dr. C. P. Gnanamuthu, Director, Zoological Laboratory, University of Madras, to whom a few bones were sent for identification, reports as follows:

'The preliminary examination of a few selected animal-bones recovered from pit 1 in Trench 362/B2 reveals that they can be identified with those of *Bos bubalus*, probably the domesticated buffalo, whose upper jaw, part of the shoulder-blade and part of the front limbs were available, and of *Axis axis* (spotted deer) the hind portions of whose jaw were also available. The nature of the bones indicates a state of semi-fossilization.'[1]

[1]The author acknowledges his indebtedness to Dr. Gnanamuthu for the identification of the bones sent to him.

Pl. XXXVIII

Nos. 1-3. Parts of the front limbs and shoulder-blade of *Bos bubalus* (domesticated buffalo).
No. 4. Part of right side of the upper jaw of *Bos bubalus.*
Nos. 5-7. Parts of the hind portion of the jaw of *Axis axis* (spotted deer).

(vi) *Miscellaneous*

Of the miscellaneous objects from the excavation, mention may be made of a spheroid ball of weathered sandstone of creamy colour with red patches, recovered from layer 3 of NV-364/A2.

(vii) *Conclusion*

On the whole, the cumulative effect of the evidence, meagre though it is, is in favour of considering the area (Locality F and its environs) as a probable area of neolithic occupation, despite the fact that none of the trenches gave any indication of the existence of a manufactory. As for the neolithic culture itself, the consensus of evidence will argue in favour of its being coeval, in the broadest sense, with the upper levels (II, I) of Sanganakallu, and the upper levels of Brahmagiri I (A and B). Apart from the pointed-butted oval-sectioned axe which is reasonably plentiful here, the most typical tool of the neolithic industry in the valley would unquestionably seem to be the pick-hoe or pick-chisel, with a twin working edge, high polish, flat, occasionally curved underside, general arched longitudinal profile and high semi-elliptical or even sub-oblong cross-section. Both from its presence here and its comparative absence in this bulk elsewhere in the Deccan, it is to be deemed as a distinctive tool-type of Nagarjunakonda valley.

Although any structural evidence of this neolithic phase is lacking at present, it may be forthcoming when more extensive excavations are conducted in all the possible areas. It is reasonable to hope that a factory might be available at some spot and around it would be found the vestiges of habitation in a more comprehensive manner. The present evidence, particularly the prolific occurrence of tools in such a limited excavation and of the ashy pits, is highly suggestive of this. The admittedly scrappy occurrence of some very small copper fragments may at least tend to give the industry a 'chalcolithic' colouring. It would be well-nigh impossible to assess the duration of the industry, on the basis of the stratigraphic evidence at our disposal at present. It seems, however, to give out the suggestion that since, on the one hand, in the two upper layers, 2 and 1, the neolithic tools continue to occur in a feeble way, and, on the other, many pieces of iron slag are available only in the upper layers but not in the lowest layer, the resident neolithic culture, at its last stage overlapped with a new (intrusive?) culture, which on the analogy of other sites, is likely to be none else but the megalithic culture. But since it would virtually be begging the question to anticipate the answer in the present exiguous state of data in this regard, it can only be hoped that further extensive excavations in this area—in the vicinity of which a few megaliths are also available—will pave the way for coming to grips with the issue.

7. EPILOGUE

Concluding our above treatment of the Old and New Stone Age industries of Nagarjunakonda, we may see that the valley, which was topographically sheltered and

withal geographically well-suited to the needs and functions of the primitive Stone Age settlers, represents a cross-section of the technological progress of early man against cyclic environmental conditions.

On the one hand, the great concentration of Lower Palaeolithic tools in the valley would not so much be against the surmise of a fairly decent size of the Stone Age settlement as of an unequally though differentially dense original forested condition of the terrain.

The functionally progressive trends in the flake-scraper equipment of the subsequent stage, located well within the valley, would imply a more confident penetration of the interior.

The prolixity of the Upper Palaeolithic blade-awl-scraper-burin outfit on the central high grounds of the valley, in the typologically still more developed stage, would sharply reflect not merely the tapping of the suitable raw material for these tools in the veins of the rocks, etc., but also a fundamental shift in the nature of occupation and appliances, no doubt caused by a change in climate. For, it would certainly imply a specific evaluation of the immediate requirements of the situation, in the picture of which unwieldy vegetation-cover and too risky big game around alike are unlikely to have existed. This would, to a degree, also imply emancipation from elemental cares.

The succeeding purely microlithic stage would plainly portray the busy and self-reliant food-gatherer who knew his small-game targets.

The further continuation of man, though presumably after a considerable lapse of time, through the revolution in the form of the neolithic industrial endeavour here, would only confirm his steady conquest of both the environment as well as the mode of life and put him on the way to community-life.

The rituals, eschatological beliefs and other non-material sociological differentiae of a stage past the neolithic barbarism would seem to be reflected in the material evidence in the shape of the megalithic monuments of the valley.

The semi-urban status the valley received in the early historic times is well-known to us.

In fine, there is a broad continuity in the albeit oscillatory regimes of cultural activity, the dark gaps of which may perhaps be cited as instances of the periodic dragging on prior to the stimuli of contacts rousing them once again. In the aggregate, they represent the march of man from savagery, through barbarism, to civilization in the valley.

The valley will go under water in the immediate future. Any attempt at further systematic collection of field-data not only here but also in the neighbouring zones falling within the catchment-area of the Nagarjunasagar Dam, in the basins of the affluents and nullah-systems of the Krishna, would undoubtedly earn a grateful acclaim from posterity.

8. ACKNOWLEDGEMENTS

In presenting this account of Stone Age of Nagarjunakonda, the author is under inevitable obligations to the many members of the Nagarjunakonda Excavation Project, who assisted him in various ways, both during the investigation of the sites and the preparation of the report. While photographs of some of the Nagarjunakonda localities and those of Naguleru basin were taken by the author himself, the photography of all the tool-specimens was painstakingly done by Shri K. S. Mani, photographer, and the printing

work by Shri Lakshminarayana, Junior Photographer, and Shri B. U. Sharma, Photo-printer. Shri K. S. Mani and Shri S. P. Gupta, Technical Assistant, also assisted the writer during his exploration of the Naguleru-basin sites. Shri M. S. Mani, Draftsman, has made a fine job of the line-drawings of the tool-specimens, besides the maps, assisted by Shri Ramana Rao, Shri Guravaiah and Shri Venkataswami, all of the Drawing Section. In the neolithic excavation the author received the ungrudging and enthusiastic assistance of Shri M. D. Khare, Pottery Assistant and now Assistant Superintendent. Shri G. R. John and others, who participated in the above work, have also earned the thanks of the author. Thanks are also due to Shri Lakshmi Dutt, Senior Draftsman, and Shri A. K. Ghosh, Draftsman, of the Headquarters office, for help in the final get-up of some of the drawings.

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THE PALLAVA ARCHITECTURE OF SOUTH INDIA

By K. R. Srinivasan

CONTENTS

1. INTRODUCTION

THE period between the latter half of the sixth and the first half of the tenth century, an interval of four hundred years, marks an important epoch in the history of south India and its culture. It coincides with the rise to power of three important dynasties, the Chāḷukyas of Badami (District Bijapur), the Pallavas of Kanchi (modern Kanchipuram) and the Pāṇḍyas of Madurai and simultaneously with the revival of Śaivism and Vaishṇavism heralded by the Nāyanmārs and Āḷvārs in the Tamil country. This religious revival, accompanied by an enormous literary output and a consequent development of art, architecture, sculpture and painting, was in no way impeded by the almost constant wars among the three dynasties, which rivalled each other for imperial power, with smaller dynasties, none the less important, thrown into the conflicts or taking sides with one or the other of the main powers. Such smaller dynasties were the Telugu-Choḷas, who had their kingdom between those of the Chāḷukyas and the Pallavas, the Muttaraiyars, who ruled over the territory between those of the Pallavas and the Pāṇḍyas, and the Gaṅgas, who held the territory south of the Chāḷukya and west of the Pallava kingdoms (fig. 1). These dynasties, like the main ones, were no less contributors to the development of art and architecture in their respective regions. In fact, there appears to have been a keen rivalry in the creation of artistic monuments in the different parts of the country under these dynasties, major and minor, with the result that the period witnessed, for the first time, a very large output of permanent monuments in stone, mostly of the Śaivite and Vaishṇavite creeds. Jainism also was still having some hold in spite of the resurgent Śaivism and Vaishṇavism, but Buddhism was vanishing.

Both geographically and politically, the Pallavas of Kanchi inevitably formed the central power. They had to hold against the Chāḷukyas of Badami during the first half of the period and the Rāshṭrakūṭas of Mānyakheṭa, who rose to importance in the place of the Chāḷukyas in the latter half of the period, on one side, and the Pāṇḍyas,

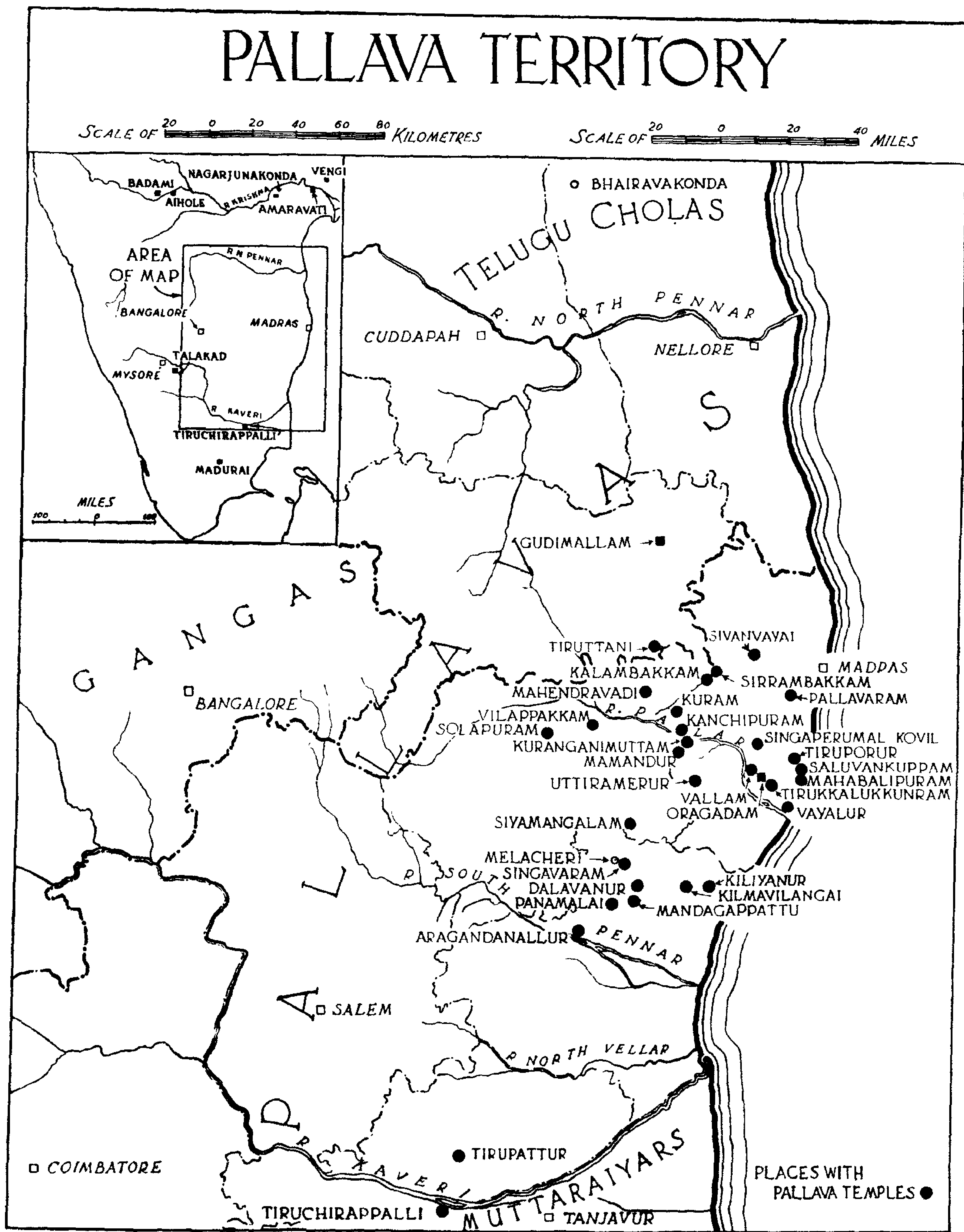

PALLAVA TERRITORY
SCALE OF 20 0 20 40 60 80 KILOMETRES
SCALE OF 20 0 20 40 MILES
BADAMI
AIHOLE
NAGARJUNAKONDA
VENGI
R. KRISHNA
AMARAVATI
AREA OF MAP
R. N. PENNAR
BANGALORE
MADRAS
TALAKAD
MYSORE
R. KAVERI
TIRUCHIRAPPALLI
MADURAI
MILES
100 0 100
BHAIRAVAKONDA
TELUGU CHOLAS
R. NORTH PENNAR
CUDDAPAH
NELLORE
GUDIMALLAM
GANGAS
BANGALORE
TIRUTTANI
SIVANVAYAI
KALAMBAKKAM
SIRRAMBAKKAM
MADRAS
MAHENDRAVADI
PALLAVARAM
KURAM
R. PALAR
VILAPPAKKAM
KANCHIPURAM
SOLAPURAM
SINGAPERUMAL KOVIL
KURANGANIMUTTAM
MAMANDUR
TIRUPORUR
SALUVANKUPPAM
MAHABALIPURAM
UTTIRAMERUR
TIRUKKALUKKUNRAM
VALLAM
ORAGADAM
VAYALUR
SIYAMANGALAM
MELACHERI
SINGAVARAM
DALAVANUR
KILIYANUR
KILMAVILANGAI
PANAMALAI
MANDAGAPPATTU
R. SOUTH PENNAR
ARAGANDANALLUR
PALLAVAS
SALEM
R. NORTH VELLAR
TIRUPATTUR
COIMBATORE
R. KAVERI
MUTTARAIYARS
TIRUCHIRAPPALLI
TANJAVUR
PLACES WITH PALLAVA TEMPLES

Fig. 1

who ruled continuously for the entire period, on the other. They developed also for the first time architecture and sculpture in the hardest varieties of local stone, which the other dynasties, particularly the Pāṇḍyas and the Muttaraiyars also took up and developed according to their own and slightly different concepts, while the Chāḷukyas and the Rāshṭrakūṭas continued the pre-existing and almost unbroken tradition of rock-architecture and sculpture of the Deccan and the north.

Though the political history of the early Pallavas would start with Siṁhavishṇu (*circa* A.D. 550-80), the founder of the line, the originator of Pallava architecture and sculpture was his great son Mahendravarman I (*circa* A.D. 580-630), who inherited from his father an empire extending from the North Pennar, north of Kanchi, to the Kaveri in the south and continued the struggle with the other contending powers, particularly the Chāḷukyas and the Pāṇḍyas. The great achievement of Mahendravarman in the field of rock-architecture was not merely his introduction of the technique of cutting into rock and the creation of stone temples for the first time in the south, but also the inevitable choice of hard rocks like granite and gneiss and the perfection his workmen attained in the new material within a short period. In this he was really *vichitra-chitta* 'the curious- or inventive-minded', as he claims himself in the exultation of his first achievement, viz. the excavation of the cave-temple for the Trinity at Mandagappattu. In his inscription[1] in the cave-temple, he says, with justifiable pride, that he created the *āyatana* (home) named after one of his titles *lakshita*, 'the distinguished', without the use of the traditional material, such as brick, timber, metal, mortar and plaster, for Brahmā, Īśvara and Vishṇu, and calls himself, therefore, *vichitra-chitta*. This Lakshitāyatana was really distinguished in two important ways: one was, as the inscription says, that it was not a construction out of the ordinary material; the other was that it was excavated in hard rock—a material not tackled either by the contemporary Chāḷukyas or the earlier dynasties of the Deccan and north India. The material wrought by the Mauryas, Āndhras, Guptas, Ikshvākus and Chāḷukyas, to mention only the most important of the earlier dynasties, was deliberately-chosen soft rock, such as sandstone, trap or similar material, as a survey of their monuments and sculptures in north India, the Deccan and west India would clearly indicate.[2]

The choice of such soft material as would lend itself to cutting and working like wood indicates that the stone-workers were really carpenters and similar craftsmen skilled in minor decorative arts who had turned masons, the choice being due to the fact that the

[1] *Epigraphia Indica*, XVII (1923-24), pp. 14 ff.

[2] The Mauryan columns and sculptures are mostly out of a grey close-grained sandstone finished with a high polish. The Buddhist cave-temples of Ajanta, Aurangabad, Karle, Bhaja, etc., are excavations into the well-formed trap abundant in those areas. In the eastern Deccan and the adjoining coastal strip, the choice of the Āndhras and Ikshvākus was the soft marble-like limestone, which adorned the famous monuments of Amaravati, Nagarjunakonda, Jaggayyapetta and other places. The earlier Orissan caves and the later ones at Vijayavada, Mogalrajapuram and Undavalli were again excavations into the sandstone outcropping from local laterite. The Guptas followed the Mauryas in the choice of sandstone as their material, and so did the Chāḷukyas of Badami. The Rāshṭrakūṭas, who mainly took over the development of architecture and sculpture in the Deccan and north Mysore, continued to employ the same soft material as at Ellora. The later Chāḷukyas, the Kākatīyas and the Hoysaḷas followed the same soft-stone tradition in their structures, the Hoysaḷas changing over from trap and sandstone to soapstone. This change had been anticipated earlier by the authors of the Bhairavakonda cave-temples in Nellore District, who excavated into a schist material closely resembling soapstone and found as an intrusion in the Udayagiri hills. In the north, the central Indian cave-temples and the medieval and later structural examples are of sandstone and like material, which, particularly sandstone, was also later chosen by the Muslim dynasties.

stone material they chose was more permanent than wood, ivory or stucco. The inscription from Sanchi mentioning the guild of the ivory-carvers of Vidiśā as the authors of one of the *toraṇas*[1] would substantiate this.

It is against this background that Mahendravarman's idea of tackling the hardest of the rocks and the success he achieved have to be viewed. In this he is to be compared with the great emperor Aśoka and the latter's grandson Daśaratha, who, perhaps for the first time in the history of India, excavated into the hard boulders of quartzose-gneiss near Gaya (Bihar). Their Barabar and the Nagarjuni caves were excavated by quarrying into the hardest rock and carving and polishing it with infinite labour, which technique started and ended there within the same century. The Mauryan artisans were, at the same time, no less adepts in the softer sandstone, and this tradition started by them continued for centuries. They could easily quarry the material in large blocks, work it to some extent on the quarry-site and transport the roughly-finished product over great distances for final erection and finish. It is, however, not till about after one thousand years, under the Pallavas, that we find hard rocks being again used either for cutting in as caves or cutting out as shrines or for building up into structural temples at places far away from the quarry-sites. Following the Pallavas, the Pāṇḍyas and the Muttaraiyars did likewise and thus established the tradition of construction in hard stone material, which, in the time of the Choḷas, reached its high watermark in the Bṛihadīśvara temples at Tanjavur and Gangaikondacholapuram. The same material continued to be employed by subsequent dynasties—the later Pāṇḍyas, the Vijayanagara rulers, the Nāyakas—and has been employed even in modern times in the south with greater dexterity in quarrying and working. Thus, Pallava architecture and art would stand distinct both in its material and technique from the rest of their contemporary counterparts as an appropriate creation of a *lakshita* (idealist), who was also a *vichitra-chitta*.

Owing to the inherent nature of the rock-material and its difference from the materials employed by the contemporary Chāḷukyas and the earlier dynasties, the technique and the results inevitably differed from the others. While the softer varieties of stone could be quarried into large blocks easily by the pick and finished with the chisel and hammer, the entire work on the hard stones would be patient quarrying and finishing with chisel and hammer alone involving greater time, labour and skill. This and the fact that the Pallava workmen, who excavated the early cave-temples, were working in a new material of hitherto-unknown qualities, mass and tensile strength naturally limited the size (depth and height) of the excavation as compared with the larger excavations of the Chāḷukyas, the cave-temples of the Deccan and western India and the caves of Orissa. The Chāḷukyan and the earlier excavators had not only the benefit of softer material but also could draw from a long experience extending to about a thousand years.

The beams, brackets and pillars of the cave-temples of the Pallavas were therefore short, very massive with almost no sculptural decoration and with the minimum intercolumnar space. Likewise, the interiors of the cave-temples and the exteriors of the cut-out temples could have only a limited amount of sculptural decoration, the few sculptures being large-sized, as opposed to the density and lavishness of sculpture and decoration in the sandstone and other materials of contemporary and earlier dates. The same will have to be said about the stone structural temples of the Pallavas and the dynasties that followed them in the south. Contrary to this, the employment of softer stones by the dynasties that succeeded the Chāḷukyas greatly tempted sculptural and other embellishments over entire spaces exposed to view. During the time of the Hoysaḷas this reached such a

[1]John Marshall and others, *The Monuments of Sāñchī* (Delhi, 1940), I, p. 242.

stage that there was no square inch of the temple-surface that was left unadorned either by sculptures or designs. The sculpture initiated by the Pallavas and developed after them did, therefore, never reach that cloying effect, and the monuments maintained a balance between architecture and decoration, the architecture tending in the earlier examples to be what may be called severe. The sculptures in the earlier cave-temples and monolithic and structural temples of the Pallavas are mainly bas-reliefs of large size, judiciously distributed and not cut more or less in the round or almost cut out as in the contemporary Chāḷukyan and Rāshṭrakūṭa examples. Whatever further embellishments the monuments needed were supplied by a thin coat of plaster over the smoothened stone surface and painting or stucco thereon. The scheme of plastering the interiors was employed for different reasons after the Mauryas in the Buddhist cave-temples and *vihāras*, where it evidently took the place of the Mauryan polish. The surface of the trap could not be finished smooth and polished like the Mauryan sandstone. Plastering was also necessary, because throughout the ages the brick and timber structures had been plastered and painted: the brick structures were plastered primarily for protection and painted, like the wooden carvings, for embellishment. Similarly, the friable nature of the soft rock needed a protective coating which was also made decorative.

The cave-temples excavated by Mahendra—the Mahendra style—are characterized by simplicity of plan and decoration and paucity of sculpture and massiveness of the pillar. Such cave-temples continued to be excavated by the successors of Mahendra almost till the close of the line, side by side with a more ornate series of cave-temples initiated by Māmalla (630-68) which has been called below the Māmalla style cave-temples, and the structural temples that were built from the time of Parameśvaravarman I (672-700). Thus, though the later kings made innovations of their own, they also adhered to the traditional type initiated by Mahendra, who first wrought in stone in south India. The Mahendra style cave-temples would fall under three periods, the temples of the first period being those excavated by Mahendra or contemporary with him, those of the second period excavated in the interval between the reigns of Māmalla and Nandivarman II (731-96) and the third period coinciding with the later Pallavas from Nandivarman II onwards.

2. CAVE-TEMPLES

A. The Mahendra style

(i) *Period I*

The cave-temples excavated by Mahendra (*circa* A.D. 580-630) are simple excavations, each consisting of a pillared verandah with a shrine cut into either the back or one of the side-walls according to the direction which the main façade or the front of the *maṇḍapa* faced. Thus, in *maṇḍapas* facing south or north, the shrine-cells were often cut laterally so as to face east or west, while in *maṇḍapas* facing east or west the shrine-cells were cut behind the *maṇḍapas*. The cave-temples cut into the living rock were necessarily designed to show the interior aspect of the structural monuments they imitated. They are essentially of the *maṇḍapa* type,[1] which have been common and are even now common all over

[1] Both according to inscriptions and popular usage, the Pallava cave-temples are called *maṇḍapas*, e.g. Kal-maṇḍakam, Orukalmaṇḍapam, Kōṭikal-maṇḍapa, Dharmarāja-maṇḍapa, Atiraṇachaṇḍa-maṇḍapa, etc. The place where the first cave-temple of Mahendra is located is itself called Mandagappattu.

south India, built for special purposes within the precincts of large temples or far away from them, on tank-bunds and river-banks and in gardens where the processional deity is taken for a temporary halt during the annual festivals—the *maṇḍapas* for *utsava, snapana, alaṅkāra* or *pārveṭṭai*. These *maṇḍapas*, which are pillared halls, open or closed, with a flat roof (or sloping roof in places with heavy rainfall), contain a small shrine either in the centre or behind.

The cave-temples excavated by Mahendra in Toṇḍai-maṇḍalam are authenticated by his own inscriptions, very often a dedicatory verse or a string of his titles, and can, therefore, form the types for the study of similar ones without inscriptions and later ones excavated by his successors. The cave-temples that are so authenticated and can be chronologically arranged, according to their general character, development, decorative and sculptural details, are the following:

(1) Lakshitāyatana (Trimūrti) cave-temple at Mandagappattu (pl. XXXIX A),
(2) Pañcha-pāṇḍava cave-temple at Pallavaram (now used as a Muslim *dargāh*),
(3) second (Śiva) cave-temple at Mamandur, called in its inscriptions *Rudravālīśvara*,
(4) Kal-maṇḍakam cave-temple at Kuranganilmuttam, very closely resembling the one at Pallavaram, though unfinished and without Pallava inscriptions,
(5) Vasanteśvara (larger) cave-temple at Vallam,
(6) Mahendra-Vishṇu-gṛiha cave-temple at Mahendravadi (pl. XXXIX B),
(7) Vishṇu cave-temple at Mamandur,
(8) Lalitāṅkura-Pallaveśvara-gṛiha (or the upper rock-cut cave-temple) at Tiruchirappalli,
(9) Śatrumalleśvarālaya cave-temple at Dalavanur (pl. XL A), and
(10) Avanibhājana-Pallaveśvara-gṛiha cave-temple at Siyamangalam.

All these cave-temples, except the one at Tiruchirappalli, are located in the Pallava country of Toṇḍai-maṇḍalam, the one at Tiruchirappalli forming the only example farther south in the Choḷa country on the bank of the Kaveri, up to which boundary Mahendravarman inherited the kingdom from his father. This monument is also the only example excavated near the summit of the hill, while the rest are nearer the base of the rocks. The unfinished excavations at Vilappakkam and Aragandanallur also belong to the Mahendra style.

The *maṇḍapa* of the cave-temples is often divided into proximal and distal sections, the outer corresponding to the *mahā-maṇḍapa* and the inner to the *ardha-maṇḍapa*. The *mahā-maṇḍapa* has on its front a row of pillars and pilasters usually four in all[1] but sometimes six or eight.[2] In all cases, the two extreme columns are pilasters *in antis*, while the intermediate ones are pillars. A similar number forming the inner row and in line with the members of the outer row separates the *mahā-maṇḍapa* and the *ardha-maṇḍapa*, as in the Mandagappattu and Pallavaram cave-temples, Rudravālīśvara at Mamandur, Kal-maṇḍakam at Kuranganilmuttam, unfinished cave-temples at Vilappakkam and Aragandanallur, Vishṇu cave-temple at Mahendravadi and the cave-temple at Siyamangalam. In all these cases, the shrine, one or more in number, is excavated into the hind walls.

[1] The examples are the Lakshitāyatana at Mandagappattu, Rudravālīśvara at Mamandur, Kal-maṇḍakam at Kuranganilmuttam, Vasanteśvara at Vallam, Śatrumalla's cave at Dalavanur, Avanibhājana's cave at Siyamangalam and Vishṇu cave at Mahendravadi.

[2] The Pañcha-pāṇḍava cave at Pallavaram, Lalitāṅkura's cave at Tiruchirappalli and the unfinished cave at Aragandanallur are examples of six-pillared and the unfinished cave at Vilappakkam of eight-pillared *mahā-maṇḍapas*.

The examples with a single shrine cut into the hind wall are the Vasanteśvara at Vallam, Vishṇu cave-temples at Mahendravadi and Mamandur and the cave-temple at Siyamangalam. The earliest example at Mandagappattu, as also the Rudravālīśvara and Kal-maṇḍakam, have a triple shrine. The Pallavaram cave-temple has five shrine-cells, while the unfinished Vilappakkam one has seven, the lateral cells of the *ardha-* and *mahā-maṇḍapas* of the Kal-maṇḍakam being later additions to the original scheme. Thus, the number and disposition of the shrines, in cases where they exceed one, are in accordance with the pillars of the *maṇḍapa* or *maṇḍapas* in front, each shrine-opening corresponding to the intercolumnar space (*aṅkaṇa*) between the pilaster and pillar on one hand and one pillar and another on the other.

The façade as well as the shrine of the Kal-maṇḍakam, Rudravālīśvara, Vasanteśvara, and the Vishṇu cave-temples at Mahendravadi and Mamandur face almost east, while those at Mandagappattu, Vilappakkam and Siyamangalam face almost west. Pallavaram is the only example in the series where the *maṇḍapa*-façade and shrines face due south. The Lalitāṅkura and Śatrumalla cave-temples at Tiruchirappalli and Dalavanur are examples with the *maṇḍapa* facing south and the shrine cut into the lateral wall—the eastern one at Tiruchirappalli and western one at Dalavanur—so that the shrines face west and east respectively. In the Dalavanur cave, the large *maṇḍapa*, with a single row of pillars and pilasters on its façade, is divided into two floor-levels, the slightly lower front section corresponding to the *mahā-maṇḍapa* and the rear section to the *ardha-maṇḍapa*. It is on the western wall of the *ardha-maṇḍapa* portion that the shrine is cut with a small porch-like pillared *maṇḍapa* in front of it, also rock-cut and standing on the floor of the *ardha-maṇḍapa* on a still higher plinth. In the case of the Tiruchirappalli cave-temple, there is, however, an inner row of pillars and pilasters very close to the hind wall, with a small passage in between, while the principal shrine is cut into the middle of the side-wall of the larger *maṇḍapa* in front between the two rows of columns. This is a feature which is not of Pallava origin, but is found in the Pāṇḍya country, to which Tiruchirappalli is nearer—witness the cave-temples at Tirupparankunram.

The plan of the cave-temples being as described above, the front elevation of the façade, which is often cut back to a varying depth into the sloping face of the rock according to the degree of the slope and the height required by the façade, is cut with an *adhishṭhāna* (basement with moulded parts) having a flight of rock-cut steps in front and the pillars and pilasters over it. On the top of the pillars and pilasters are cut massive *potikās* (corbels) with a heavy beam. The rough overhanging ledge projecting above the beam with its natural irregular outline is left as a *kapota* (cornice) and is rarely moulded into a regular flexed cornice and ornamented by *kūḍu*-arches. This kind of well-formed *kapota* with *kūḍu*-arches is found only in the Dalavanur cave-temple, while in the rest of Mahendra's monuments the rough ledge itself serves as the *kapota*. The Pallavaram cave-temple has, over its rough *kapota*, mouldings corresponding to the terrace-work of structural *maṇḍapas*—a feature which is also noticed at Dalavanur.

The massive pillars are divided into three regions, the top and bottom of which are cubical *śadurams* and the intervening part bevelled at the corners so as to have eight faces and an octagonal plan, called *kaṭṭu*. While the pilasters also correspond to this shape in the Mandagappattu, Vallam and Siyamangalam cave-temples, they remain tetragonal throughout from base to top in the others. In some rare cases, cut on the top of the pillar, or pilaster and below the *potikā* is a plank of sides slightly greater than the top of the pillar corresponding to the abacus (*phalaka*), a constituent member of the capital of pillars in general. This is found in the Dalavanur cave-temple, where the lower surface of the *phalaka* is also marked by lotus-petals—the *padma* being another component of the normal

pillar-capital. Thus, the presence of these suggests that the upper *śaduram* would correspond to the lower members of the capital, viz. the *kalaśa*, *tāḍi* and *kumbha*.[1]

The faces of the top and bottom *śadurams* are ornamented with engraved circular lotus-medallions. The earlier caves, those at Mandagappattu, Pallavaram and Kuranganilmuttam and the Śiva caves at Mamandur and Vallam, do not have them. While they are all lotus-medallions, as at Mahendravadi and Dalavanur and in the Vishnu cave at Mamandur, at Tiruchirappalli and Siyamangalam there are, in addition, other motifs incised inside circular medallions, such as *makaras*, *kinnarīs*, *mātaṅga-nakras* and scrolls of foliage and floral designs. The pilasters are either adorned or unadorned in consonance with the pillars, the only notable feature being that in the Siyamangalam cave-temple, the place of the top medallion is taken by a small bas-relief panel.

The massive corbels either have a curved profile or are bevelled with an angular outline. The undersurface of the curved-profile corbels is often cut into a series of roll-mouldings or *taraṅga* with a median flat band, as if binding them, called *paṭṭa*. The Śiva cave-temple at Mamandur alone has a bevelled corbel with an angular profile, while among the rest with curved corbels it is the Tiruchirappalli and Siyamangalam ones alone that have the *taraṅga* and *paṭṭa* in addition.

Of the sculptures, the most important ones would be the figures of door-keepers or *dvāra-pālas*. There are two *dvāra-pālas* at either end of the façade of the *maṇḍapa* in the earliest cave-temple at Mandagappattu and the one at Dalavanur, but none at all at Pallavaram and in the Vishṇu cave at Mamandur. At Siyamangalam, the last of the series, there are two niches enclosed inside *stambha-toraṇas* containing two figures of warriors in the position of *dvāra-pālas*. In the Śiva cave at Mamandur and in the caves at Kuranganilmuttam, Vallam, Tiruchirappalli and Siyamangalam, the *dvāra-pālas* are placed inside the *maṇḍapa* on either side of the shrine-entrance in pairs according to the number of such entrances. The two examples at Dalavanur and Siyamangalam are, therefore, unique in having *dvāra-pālas* both on the main façades and on the shrine-fronts inside. The *dvāra-pālas* are two-armed and either face front or are in semi-profile, resting on a massive club entwined by a serpent. Some of them have often two horn-like appendages on their heads, a feature not exclusively Pallava, as it is found in the contemporary Chāḷukyan examples and in the cave-temples round about Vijayavada and those at Bhairavakonda, as also in the Pāṇḍya country. The Tiruchirappalli cave-temple is unique in another respect in that it is the only example among Mahendra's cave-temples that has a large bas-relief sculpture, depicting the Gaṅgāvataraṇa scene (pl. XLIX A), in addition to the *dvāra-pālas*. The Dalavanur cave-temple has, on the other hand, a *makara-toraṇa* spanning the entrance between the two central pillars, the *makaras* on either side being carved on the front faces of the corbels concerned, suggesting that the corbels represent *makara-potikās*. The *makara-toraṇa* is found again only in the Siyamangalam cave-temple, but surmounting the niche or *deva-koshṭha* containing the two warrior-like figures on either side of the *maṇḍapa*-façade. The two small bas-reliefs, taking the place of the decorative medallions, on the tops of the pilasters of the Siyamangalam cave-temple are those of dancing Śiva (perhaps the earliest representation of the form in Pallava sculpture) and Śiva and Umā standing with the bull behind. The front face of the top *śaduram* of the pillars, on the other hand, has a lion with uplifted tail in place of the decorative medallion.

[1] Such a pillar without the capital-components has been described by Jouveau-Dubreuil and others as pillars without 'bulbous' capitals.

The shrine-cells in all the cases are now empty and do not contain either a rock-cut *liṅga* (as is common in the Chāḷukya, Pāṇḍya and Muttaraiyar cave-temples, or is seen at Bhairavakonda, where the *liṅga*-pedestal at least is rock-cut) or any appropriate Śiva or Vishṇu image. Often there is a slight relief of a pedestal cut at the base of the back wall, indicating that the deity in worship was either a wall-painting (*bhitti-chitra*) or was picked out in stucco from the plastered wall above the line of the pedestal. Tell-tale traces of painted plaster extant in many cases, as also the absence of any original water-outlet in the cell, would confirm this. The shrine-fronts have often a moulded *adhishṭhāna* (fig. 2) and a rock-cut flight of steps (*sopāna*) with a semi-ciruclar *chandra-śilā*. The pilasters are mostly plain from base to top without capitals, but in some cases with the capital complete as at Tiruchirappalli. The entablature (*prastara*) has a curved *kapota* with *kūḍu*-arches.

(ii) *Period II*

The cave-temples of Period II in the Mahendra style, excavated by Narasiṁhavarman I Māmalla (630-68), Parameśvaravarman I (672-700) and Narasiṁhavarman II Rājasiṁha (700-728), arranged in a chronological order on a comparative basis, confirmed in some cases by epigraphical evidence, are eight in number:

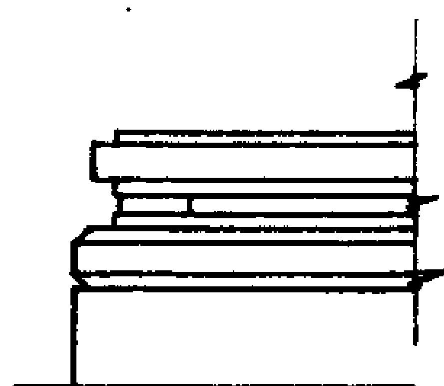
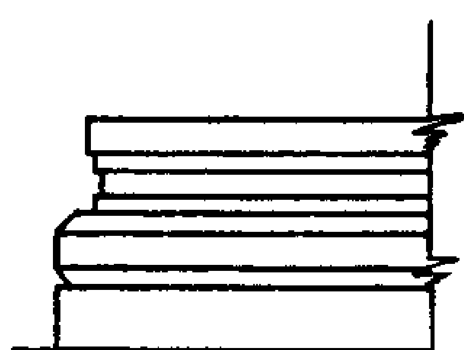
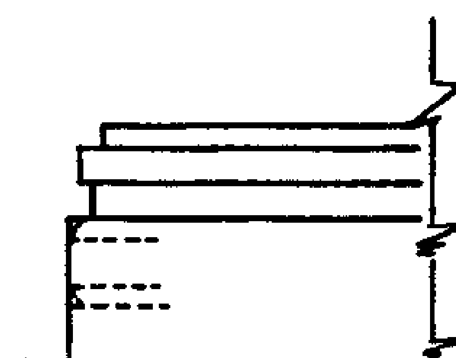
(1) Orukal-maṇḍapam at Tirukkalukkunram (pl. XLI),
(2) Koṭikal-maṇḍapam at Mahabalipuram (pl. XL B),
(3) Narasiṁha cave-temple at Singapperumalkovil,
(4) Raṅganātha cave-temple at Singavaram,
(5) and (6) two unfinished cave-temples at Mamandur,
(7) Dharmarāja-maṇḍapa or Atyantakāma cave-temple at Mahabalipuram, assignable to Paramêśvaravarman I, and
(8) Atiraṇachaṇḍa-maṇḍapa at Saluvankuppam, excavated by Narasiṁhavarman II Rājasiṁha (pl. XLII A).

The Śikhari-Pallaveśvara cave-temple at Melacheri near Singavaram, though bearing a Pallava name and situated in Toṇḍai-maṇḍalam, appears to be an aberrant example, not of Pallava origin or type, since the character of its pillar, pilaster and corbel is different from those of Pallava cave-temples; it has in addition a rock-cut *liṅga* with *āvuḍaiyār* in its central shrine, a feature unknown to the authentic Pallava cave-temples of Toṇḍai-maṇḍalam,[1] including the solitary example at Tiruchirappalli in the Choḷa country.

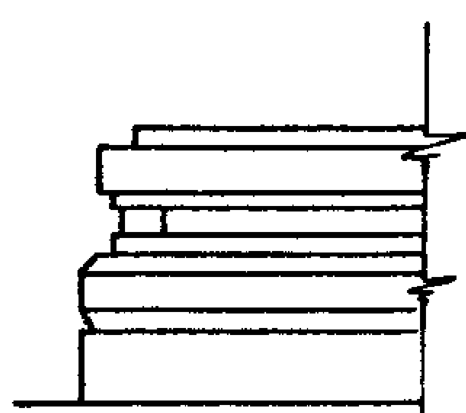
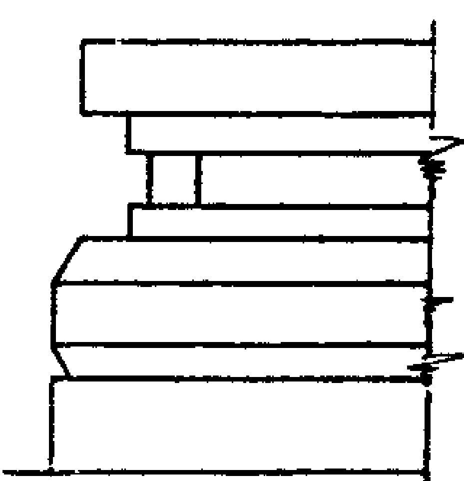
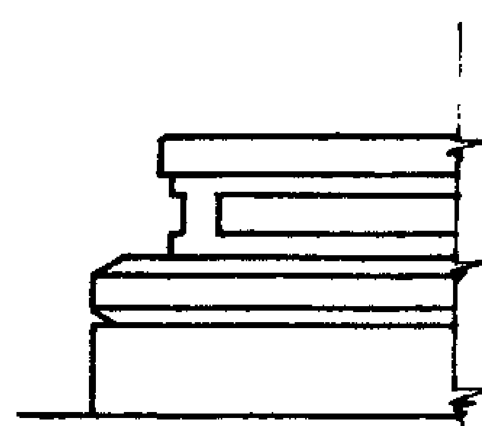
Among these cave-temples, those at Singavaram and Singapperumalkovil were dedicated to Vishṇu and the Koṭikal-maṇḍapa to Durgā, the rest being dedicated to Śiva. While none of the Śiva cave-temples contains a rock-cut *liṅga*, the two Vishṇu cave-temples contain stucco figures of Vishṇu forms, now modernized. The Atiraṇachaṇḍa-maṇḍapa of Rājasiṁha alone contains a bas-relief panel of Somāskanda on the back wall of the cell, in addition to two more on the back wall of the *maṇḍapa*, one on either side of the shrine. The carving of a bas-relief on the back wall of a shrine in place of a painting or stucco relief, particularly Somāskanda, appears to have started from the time of Parameśvaravarman I, as the present study of the cave-temples has shown. Such a Somāskanda relief has been cut in the cave and monolithic examples started by Māmalla and completed

[1] The name of Chandrāditya, found in the inscription as the excavator of the Pallaveśvara cave, *South Indian Inscriptions*, XII (1943), no. 115, is not known in Pallava genealogy, nor has he been satisfactorily assigned to any other prominent dynasty.

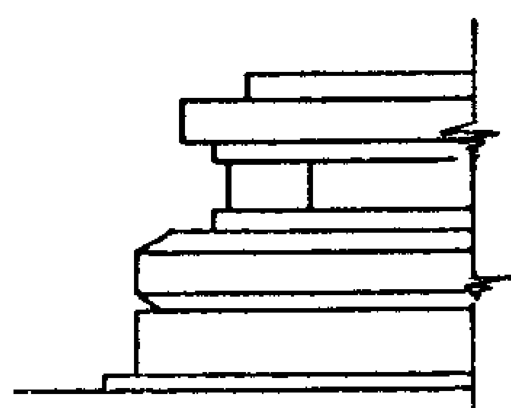
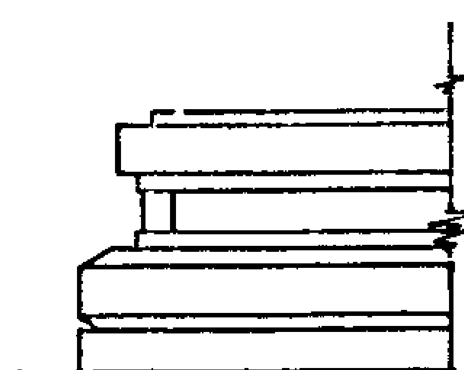
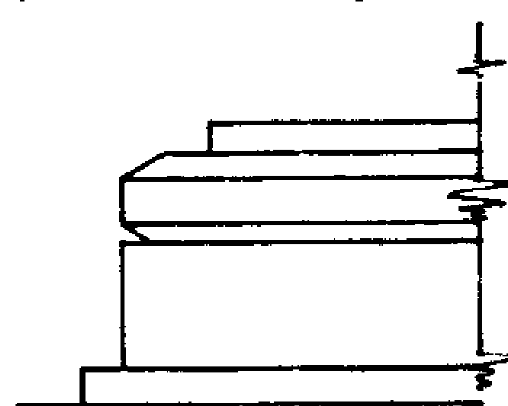
ADHISHṬHĀNA TYPES IN PALLAVA CAVE-TEMPLES

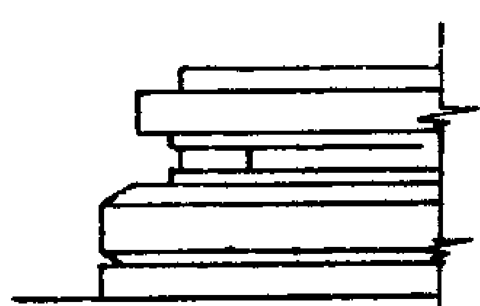
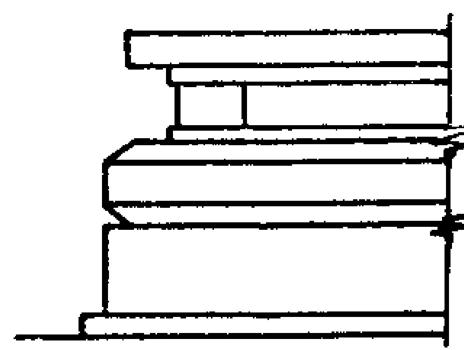
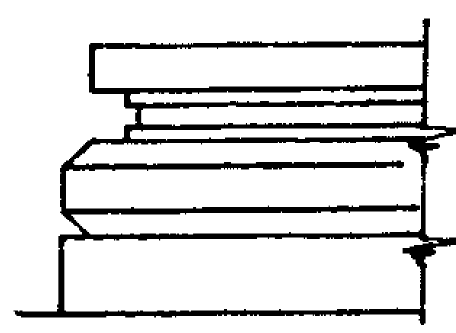
RUDRAVĀLĪŚVARAM CAVE-TEMPLE • ḲAL-MAṆḌAKAM CAVE-TEMPLE • MAHENDRAVADI CAVE-TEMPLE

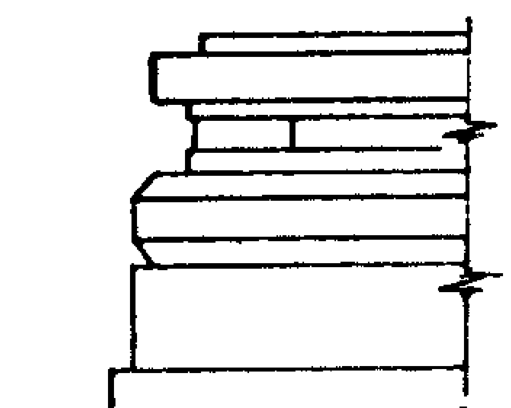
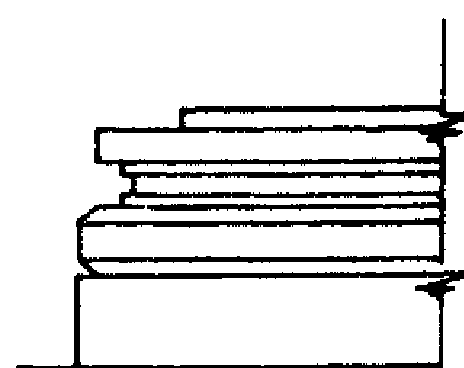
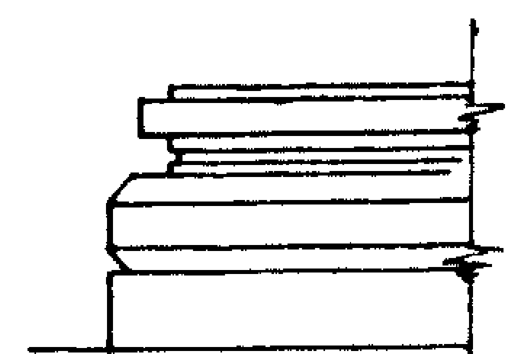
MAMANDUR VISHṆU CAVE-TEMPLE • ŚATRUMALLA'S CAVE-TEMPLE • LALITĀṄKURA'S CAVE-TEMPLE

ORUKAL-MAṆḌAPAM • ḲOṬIKAL-MAṆḌAPAM • DHARMARĀJA-MAṆḌAPA

ḲONERI-MAṆḌAPAM • VARĀHA-MAṆḌAPA • MAHISHAMARDINĪ MAṆḌAPA

TRIMŪRTI CAVE-TEMPLE • RĀMĀNUJA-MAṆḌAPA • ĀDIVARĀHA CAVE-TEMPLE

SCALE OF 1 0 1 2 3 4 5 6 FEET

SCALE OF 1 ¾ ½ ¼ 0 1 METRES

FIG. 2

by Parameśvaravarman I, as in the Dharmarāja-ratha and Mahisha-mardinī cave at Mahabalipuram.

While the general features enumerated for the cave-temples of Period I prevail in Period II as well, there is a tendency for the pillars of the latter period to become thinner and taller, sometimes flatter with an oblong section and the space between them wider.

All the cave-temples of this period also consist of a pillared *maṇḍapa* with one or more shrine-cells behind, the shrine-cell often with its frontage projecting into the *maṇḍapa*. While all of them have a single shrine-cell behind, the only example with a triple shrine-cell is the Dharmarāja-maṇḍapa. In all cases, the *kapota* of the *maṇḍapa* still continues to be the rough rock ledge projecting above the façade, not moulded into a regular *kapota* and devoid of *kūḍu*-arches. The corbels are bevelled in all cases except in the Atiraṇachaṇḍa-maṇḍapa of Rājasiṁha, which has *taraṅga-potikās*, the bevelling in the case of the Singavaram cave-temple being very obtuse and of very unusual form.[1] The same cave-temple also has a *phalaka* interposed between the corbel and the pillar or pilaster below. All the cave-temples have two pillars and two pilasters on the façade, the pillars with two *śadurams* and an intervening *kaṭṭu* and the pilasters tetragonal, except in the case of Singavaram, where the *śadurams* and *kaṭṭus* are present with lotus-medallions embellishing the former. Singavaram is also the only example in this series which has two *dvāra-pālas*, one on either side of the façade of the front *maṇḍapa*.

The *maṇḍapa* is divided by an inner row of pillars and pilasters into *ardha-* and *mahā-maṇḍapas* in the Orukal-maṇḍapam, Raṅganātha cave-temple and Dharmarāja-maṇḍapa, while in the others, there is only a single *maṇḍapa*. Projected shrine-cells with *adhishṭhāna*, pilasters and *kapota* with *kūḍu*-arches are found in all cases except in the cave-temples at Singapperumalkovil and Singavaram. In some cases the pilasters of the shrine-fronts have the capital-components, while in others they are simple shafts without capitals. In the Orukal-maṇḍapam and Dharmarāja-maṇḍapa the *dvāra-pālas* have been cut on either side of the central shrine, and there are *dvāra-pālikās* on either side of the central shrine of the Koṭikal-maṇḍapam, which, significantly, is dedicated to Durgā. They are absent in the corresponding places in the other cases. The Orukal-maṇḍapam has, in addition, sculptures of Brahmā and Vishṇu on the back-wall of the *ardha-maṇḍapa* on either side of the projected shrine-front and two more figures like *dvāra-pālas* on either side-wall of the *mahā-maṇḍapa*. In all the examples, the shrine-cell does not contain any sculpture of the main deity, except in the Atiraṇachaṇḍa-maṇḍapa, as mentioned above (p. 122). The Singavaram cave-temple has, like the one at Siyamangalam, panel-sculptures of two small female devotees on the pilasters of the inner row. There is also a very fine Mahisha-mardinī sculpture on the rock-face adjoining the façade of the Singavaram cave (pl. LII B), which is perhaps the best specimen of Durgā in the Pallava period. Cave 3 at Mamandur, though unfinished, indicates a very ambitious attempt to excavate a larger cave-temple with a pillared verandah running round a string of five central shrines.

(iii) *Period III*

The cave-temples of Period III in the Mahendra style are less interesting. The Kilmavilangai cave-temple is the only example in the Pallava country (Toṇḍai-maṇḍalam)

[1] The corbel with a curved profile (often with *taraṅga*), which is characteristic of the Chāḷukyan examples, thus appears to have been only a passing phase in Pallava architecture. The corbels with a bevel and sharp angle becomes more common in later Pallava and contemporary Pāṇḍya and Muttaraiyar examples in the south. The later evolved types of the Chola, Vijayanagara and Nāyaka corbels are but derivatives of the bevelled type.

of a simple rock-cut cell without a rock-cut *maṇḍapa* in front, but such cell-shrines are more common in the Pāṇḍya and Muttaraiyar areas, most of them contemporary with the later Pallava period. It contains a flat bas-relief of Vishṇu inside the narrow cell. The two smaller cave-temples at Vallam, one dedicated to Vishṇu with very thin pillars and bevelled corbels on the façade (now broken) and the other to Śiva, would also belong to the same period.

B. The Māmalla Style

Mahendra's worthy successor Narasiṁhavarman I Māmalla (630-68), in addition to excavating a few cave-temples in the Mahendra style, initiated a new and more ornate series of cut-in cave-temples, cut-out shrines (*vimānas* or *rathas*) and some open-air bas-relief compositions of considerable size. The cave-temples in the Māmalla style, which continued to be in vogue for about two generations after him or were completions by his immediate successors of those initiated by him, are all confined to Mahabalipuram. The most outstanding advance noted in these caves is a fuller representation of the *maṇḍapa* in its frontal and interior aspects, making the stone copies more true to their contemporary structural originals. While in the Mahendra style the *maṇḍapa*-façade stops short of the entablature (*prastara*), in most cases with an unfinished *kapota* (excepting Dalavanur which has a finished one, above, p. 120), in the Māmalla style the *prastara* is fully finished with *kapota* and *kūḍu*-arches and also carries the string of miniature shrines, mostly *śālās* (oblong with wagon-top roofs) constituting the *hāra* with interconnecting lengths of cloisters.

The pillars (fig. 3) of the façade resemble more the conventional type of contemporary structural examples in having capital-components in addition to being more slender and taller than those of the Mahendra style. The capitals contain all the members mounted on the top of the shaft such as *kalaśa*, *tāḍi*, *kumbha*, *padma* and *phalaka*, the *phalaka* being omitted in some cases. A notable example, marking, as it were, the transition from the Mahendra to the Māmalla style, is to be found in the Koneri-maṇḍapam, where the façade-pillars are slender and tall as in the Mahendra style, while the pillars in the inner row are with capitals in the Māmalla style. The bases of the pillars are often found shaped into squatting *vyālas* and lions. The shrine-cells, in all cases well-projected into the *maṇḍapa*, have all the *aṅgas* of a *vimāna*-front, viz. moulded *adhishṭhāna*, pilasters or *kuḍya-stambhas* with capital-components, *prastara* with *kapota* and *kūḍu*-arches; the further superstructure is not shown in the interior aspect of the *maṇḍapa*, as it would be normally impossible to see it from inside a *maṇḍapa* surrounding the shrine itself and as such is not usual in the structural originals. The *prastara* of the shrines abut the ceiling of the *maṇḍapa*.

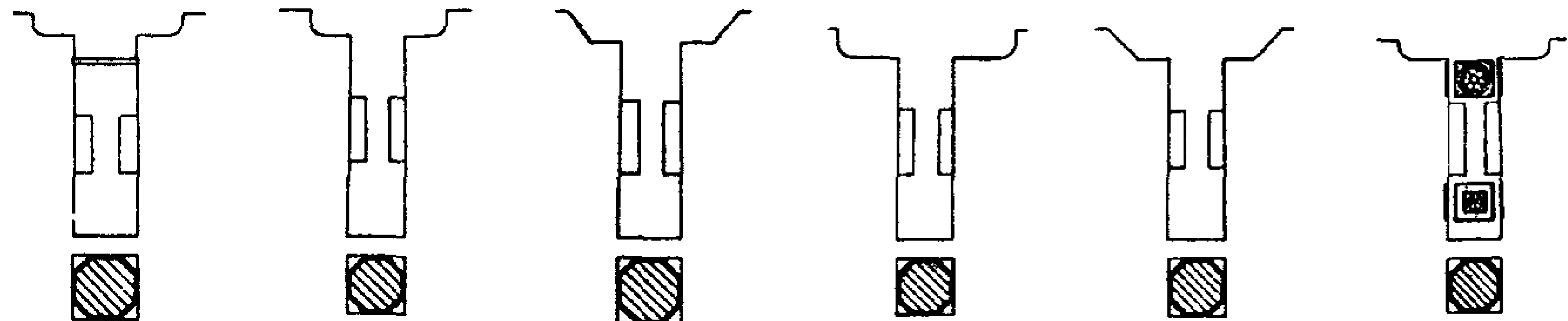
There are eight examples of this style in various stages of completion; arranged in a chronological and stylistic sequence, they would be as follows:

(1) Koneri-maṇḍapam cave-temple,
(2) Varāha-maṇḍapa cave-temple (pl. XLII B),
(3) Mahisha-mardinī-maṇḍapa (or Yamapuri),
(4) Pulipudar-maṇḍapam,
(5) an unfinished cave-temple near Koneri-maṇḍapam,
(6) Pañcha-pāṇḍava-maṇḍapa (pl. XLIII A),
(7) Ādivarāha cave-temple (Parameśvara-Mahāvarāha-Vishṇu-gṛiha), and
(8) Rāmānuja-maṇḍapa cave-temple.

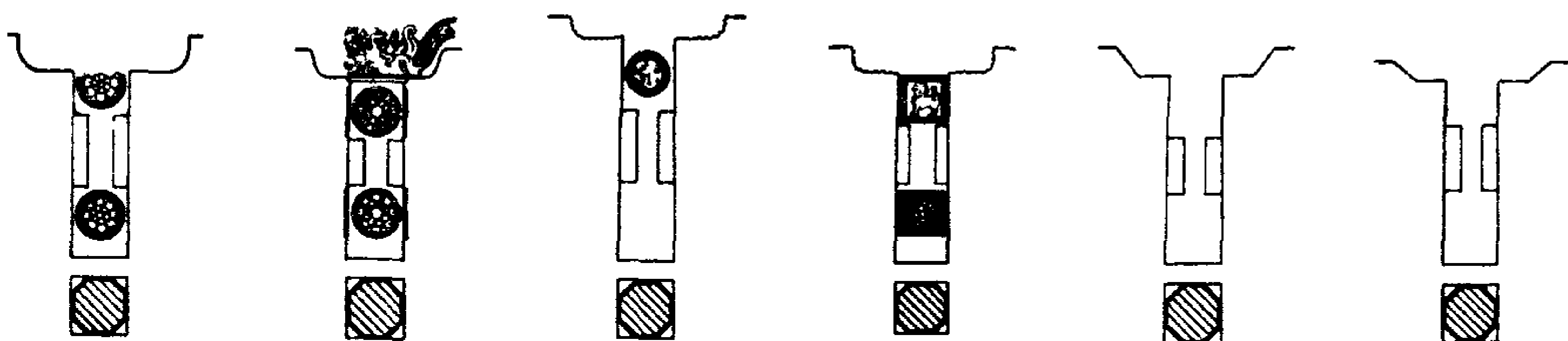
Of these, the Varāha- and Rāmānuja-maṇḍapas are examples with a single *maṇḍapa* not divided into *ardha*- and *mahā-maṇḍapas*, while the Koneri-maṇḍapam and

PILLAR TYPES IN PALLAVA CAVE-TEMPLES

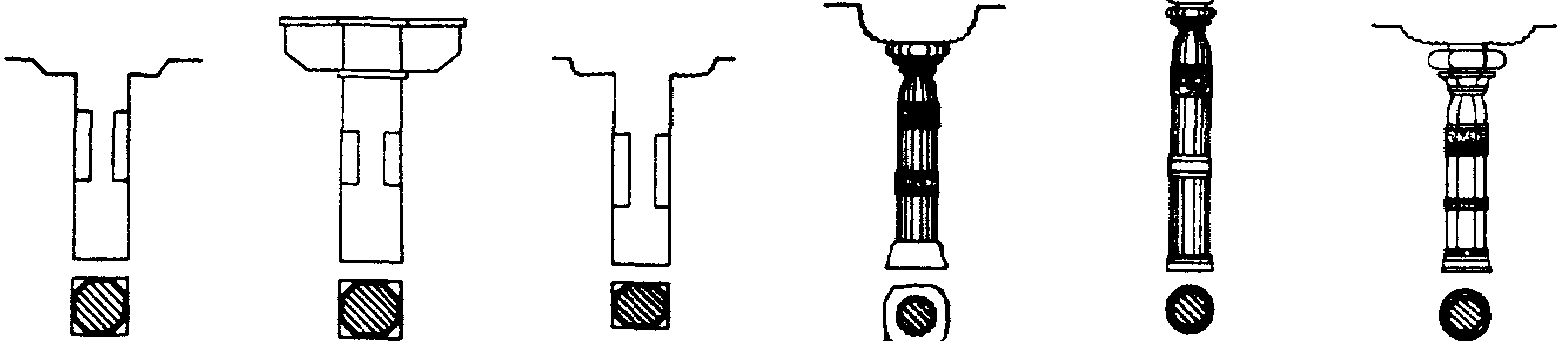
SCALE OF FEET 2 1 0 2 4 6 8 10 SCALE OF METRES 1 0 2 3



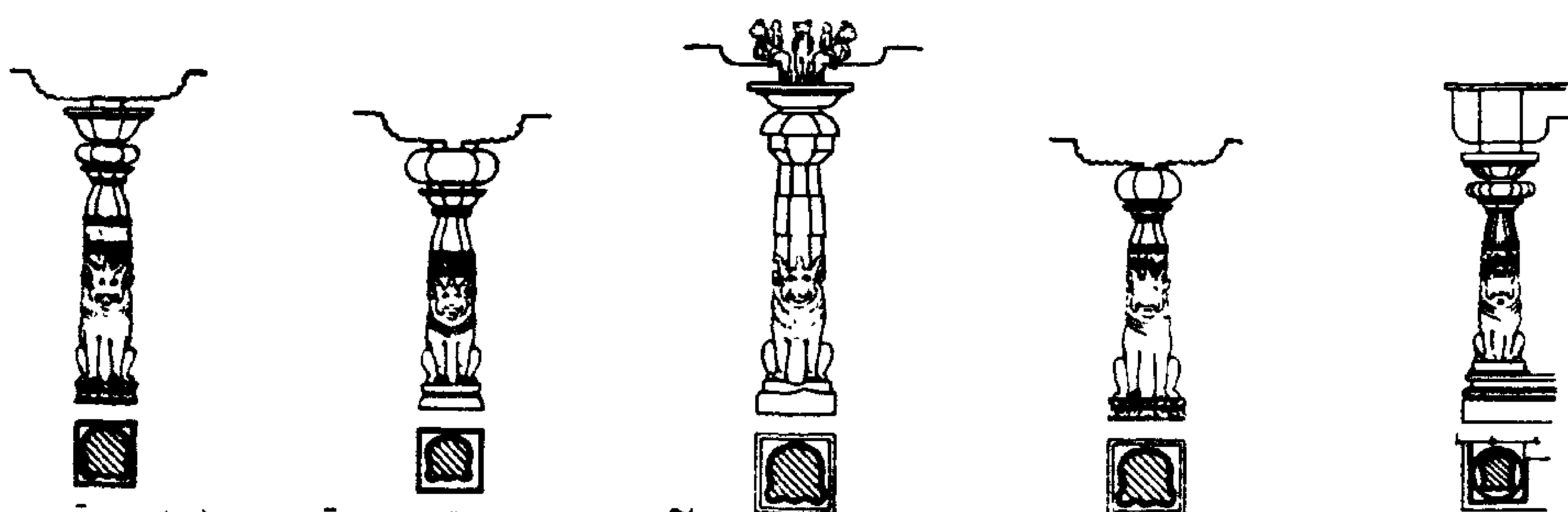
MANDAGAPPATTU • PALLAVARAM • MAMANDUR-II • KURANGANIMUTTAM • VALLAM-I • MAHENDRAVADI



MAMANDUR-I • DALAVANUR • TIRUCHIRAPPALLI • SIYAMANGALAM • TIRUKKALUKKUNRAM • KOṬIKAL (M)



SINGAPERUMAL KOVIL • SINGAVARAM • SALUVANKUPPAM • KONERI (M) • MAHISHA-MARDINĪ (M) • ĀDIVARĀHA (M)



VARĀHA (M) • ĀDIVARĀHA (M) • PAÑCHA-PĀṆḌAVA (M) • RĀMĀNUJA (M) • MAHISHA-MARDINĪ (M)

(M)-MAHABALIPURAM

Fig. 3

the Ādivarāha cave-temple have both *ardha-* and *mahā-maṇḍapas*. The Mahisha-mardinī-maṇḍapa is peculiar in that its principal central shrine has a projected pillared portico occupying the floor of the larger *maṇḍapa* in front, as has been anticipated in Mahendra's cave-temple at Dalavanur (above, p. 120). The Pañcha-pāṇḍava-maṇḍapa, which is unfinished, shows an attempt to cut a central shrine with a surrounding cloister, a *maṇḍapa* with two rows of pillars, running all round. The Varāha-maṇḍapa and the Ādivarāha cave-temple are examples with a single shrine-cell, while the Mahisha-mardinī- and Rāmānuja-maṇḍapas are examples with three shrine-cells. The Koneri-maṇḍapam has five shrine-cells in a row.

These Māmalla cave-temples show a marked advance over the preceding group in plastic art as well: they contain a wealth of large sculpture, often depicting important legends such as Mahisha-mardinī (pl. LI B), Ananta-śāyin (pl. LI A), Bhū-Varāha (pl. XLIX B) and Trivikrama (pl. L), besides other sculptures such as Gaja-Lakshmī (pl. LII A), Durgā, Brahmā, Hari-Hara, etc., the earliest extant representations of the respective forms. The Ādivarāha cave-temple is unique in having two royal portraits with the respective names inscribed, one of Narasiṁhavarman (Māmalla) and the other of Mahendravarman, both with their queens. The *dvāra-pālas* are always found inside, flanking the shrine-entrances and not outside on the façade as in some cases of the Mahendra style cave-temples. The Rāmānuja-maṇḍapa, the Dharmarāja-maṇḍapa and the Ādivarāha cave-temple contain inscriptions of Parameśvaravarman I, showing that they were either excavated or completed by him. While the Ādivarāha cave-temple, which was completed by Parameśvara contains a stucco figure of Varāha (now modernized) inside the shrine, the Mahisha-mardinī cave-temple contains a bas-relief of Somāskanda on the back wall of the shrine sculptured in the time of Parameśvara. The Rāmānuja-maṇḍapa of Parameśvara also contained such a bas-relief, as would be indicated by the still extant outlines. This *maṇḍapa* has been badly mutilated by the removal of the three shrines in an attempt to convert the whole into a large hall by the later Vaishṇavite occupants. The two group-sculptures on the end walls of the *maṇḍapa* have been erased. At either flank of the façade of this cave-temple are cut two miniature models of simple *vimānas* similar to the model *vimāna* found in the large panel depicting Arjuna's Penance (pl. LIII), which is a remarkable sculptural achievement of this period and a landmark in all Pallava sculpture.[1]

The Yāḷi-maṇḍapam and similar ornamental pavilions stand apart from either group of cave-temples and belong to the period of Rājasiṁha. The Yāḷi-maṇḍapam at Saluvankuppam (pl. XLIII B), familiarly called the Tiger Cave, is a small oblong pavilion or *maṇḍapa* excavated on the eastern side of a boulder, its *adhishṭhāna* and pillars with rampant lions cut over a lower platform reached by a flight of steps. It is surrounded by an arched frieze of eleven large *vyāla*-heads, mistakenly called tiger-heads. To its south, on the same rock-face, are sculptures of two elephants, with *howdahs* and a *dhvaja* in between, and a horse at the extreme. On the northern face of the rock is carved the front of a large lion with a niche in its body enshrining Mahisha-mardinī. A smaller replica of this Yāḷi-maṇḍapam is found on the surf-beaten boulder to the south of the Shore temple (below, p. 133), and to the north of the same temple is another rock, called the Mahisha-mardinī rock, with a large lion-face and a Durgā niche.

The Yāḷi-maṇḍapam obviously served as a resting place during festivals, since the name of the place according to the inscriptions is Tiruveḻuchiyūr (*tiruveḻuchi* meaning 'starting in procession').

[1] For a description of this sculpture, see T. N. Ramachandran, 'Kirātārjunīya in Indian art', *Jour. Ind. Soc. Oriental Art*, XVIII (1950-51), pp. 1 ff. The other large sculpture represents Kṛishṇa as Govardhana-dhārin.

3. MONOLITHIC TEMPLES

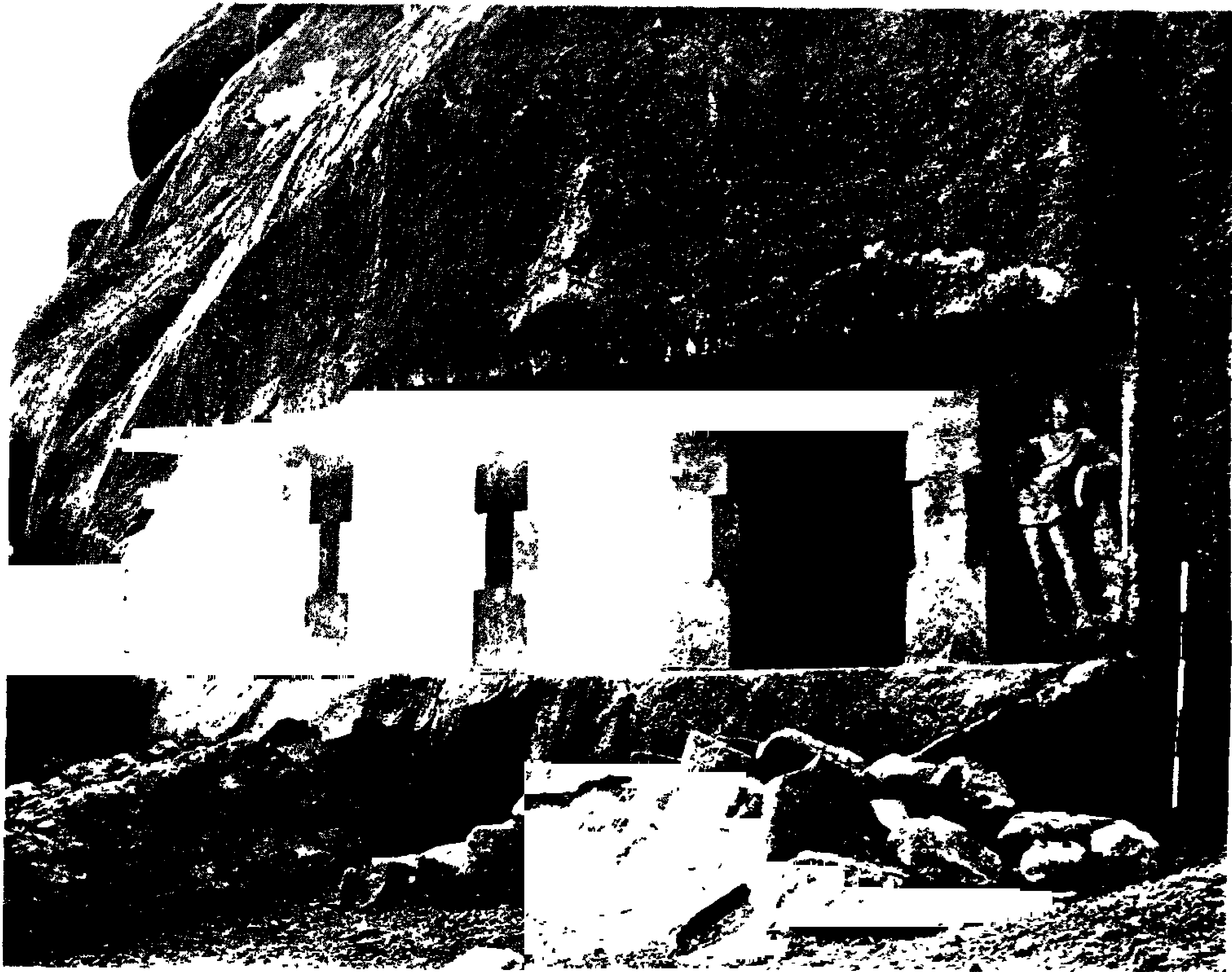
The more outstanding achievement of Māmalla would be the cut-out shrines or *vimānas*, popularly called *rathas*. They are, in fact, large sculptures of architectural models carved out of entire boulders; in this Māmalla stole a march over his rivals in the Deccan and the south. The *rathas* are nine in number, all confined to Mahabalipuram, which was perhaps in Māmalla's time a regular school of architecture and sculpture, where *maṇḍapa*-fronts and shrine-models were being reproduced in stone side by side with large sculptures *in situ*. To this series of *rathas* is to be added the Trimūrti cave-temple, which is a representation of three contiguous shrine-fronts, unlike the other cave-temples, which are representations of *maṇḍapas* with one or more shrine-cells excavated inside and as such representing, in front elevation, the façade of a *maṇḍapa*. Mention may also be made of the bas-relief models of shrines among the sculptural compositions and on the façades of a few *maṇḍapas* and *śikharas* of *rathas*. The *rathas*, along with the Trimūrti cave-temple and relief models, afford enough material for the study of the contemporary *vimāna*-architecture. Arranged in a sequence, they will be as follows:

(1) Draupadī-ratha,
(2) Nakula-Sahadeva-ratha,
(3) Arjuna-ratha,
(4) Dharmarāja-ratha (pl. XLIV A),
(5) Bhīma-ratha,
(6) Gaṇeśa-ratha (pl. XLV),
(7) southern Piḍāri-ratha,
(8) Valaiyankuṭṭai-ratha (pl. XLIV B),
(9) northern Piḍāri-ratha,
(10) Trimūrti cave-temple, with three shrine-fronts (pl. XLVI), and
(11) the bas-relief models (pl. XLVII) in the Arjuna's Penance, on the façade of the Rāmānuja-maṇḍapa and on the front *śikhara*-face of the Nakula-Sahadeva-ratha and those on the end-faces of the *śikharas* of the Bhīma- and Gaṇeśa-rathas.

The monolithic temples, being cut-out examples, show not only the entire external aspect of a *vimāna* with its *ardha-maṇḍapa*, but also to some extent the interior aspects. Further, a study of these monoliths and their extant stages of completion illustrate the method of their carving, which proceeded from top downwards, unlike the structural temples, which are built up from the base to the finial.

The installation of the finial in a structural temple not only marks the completion of the structural work but also coincides with the ritual (*kumbhābhisheka*) which consecrates the shrine. This traditional consecration by the installation of *stūpi*, enjoined by the *āgamas*, obviously prevented the makers of the monolithic *vimānas* from carving the *stūpi* first, as should ordinarily be the case while the working proceeds from the top to the base. This will explain why in all these monoliths the *stūpis* are not integral with the monolith but are separate pieces inserted into special sockets, after the completion of the *vimāna* from *śikhara* downwards.

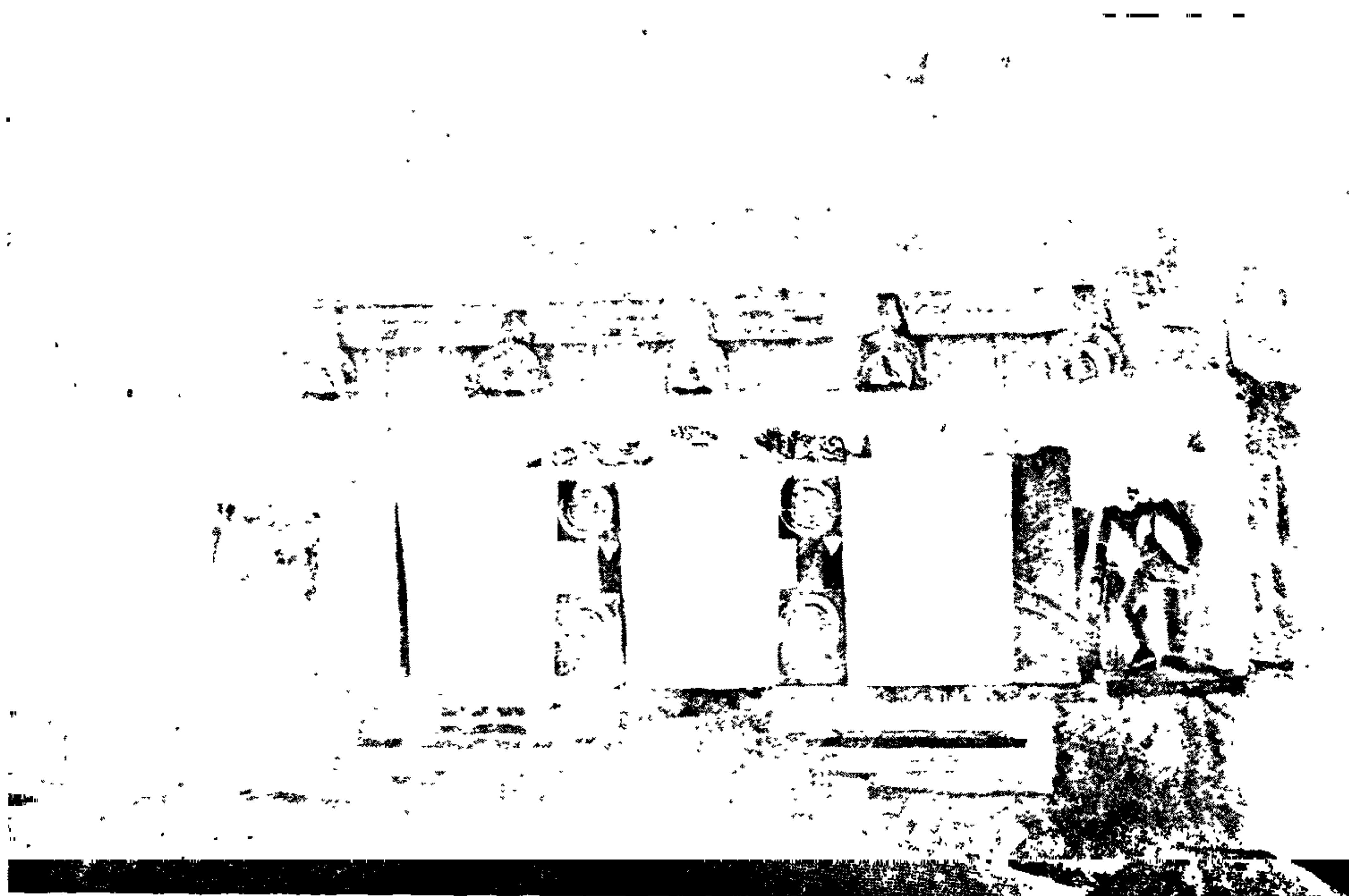
The carving of the monoliths appears to have continued for two generations after Māmalla through the reigns of Mahendravarman II (668-72) and Parameśvaravarman I (672-700), when perhaps the sculptures of the principal deities, in bas-relief, as extant in some of the central shrines, were introduced. The successors of Parameśvaravarman, however, took up more seriously the construction of structural temples, in which work that king himself had made some advancement.



A. *Mandagappattu: Lakshitāyatana.* *See page 119*



B. *Mahendravadi: Mahendra-Vishnu-griha.* *See page 119*



A. *Dalavanur: Śatrumalleśvarālaya.* *See page 119*



B. *Mahabalipuram: Koṭikal-maṇḍapam.* *See page 122*



Tirukkalukkunram: Orukal-mandapam. *See page 122*

To face pl. XL.



A. *Saluvankuppam: Atiraṇachaṇḍa-maṇḍapa.* *See page 122*



B. *Mahabalipuram: Varāha-maṇḍapa.* *See page 125*

To face pl. XLIII

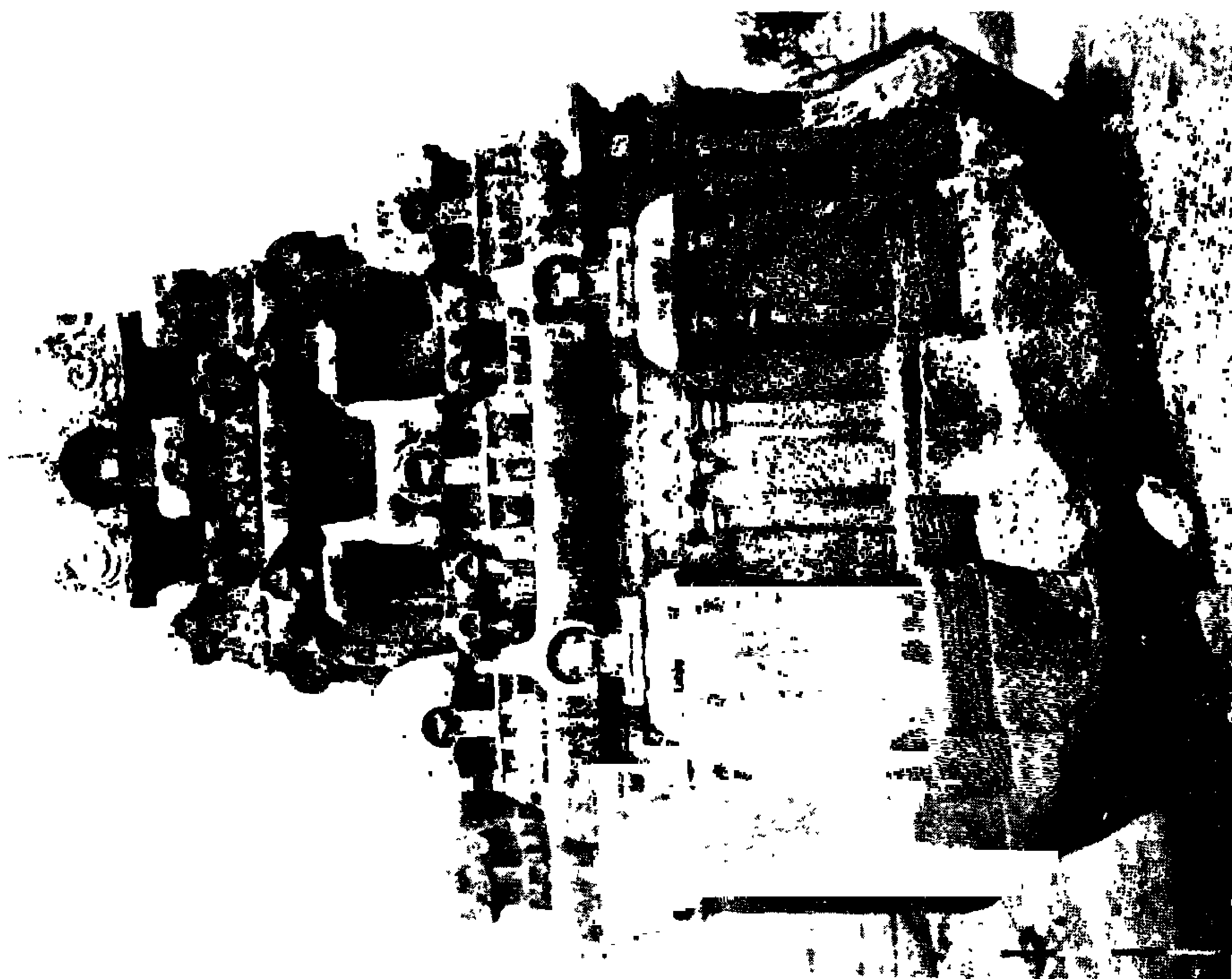


A. *Mahabalipuram: Pañcha-pāṇḍava-maṇḍapa.* *See page 125*



B. *Saluvankuppam: Yali-maṇḍapam.* *See page 127*

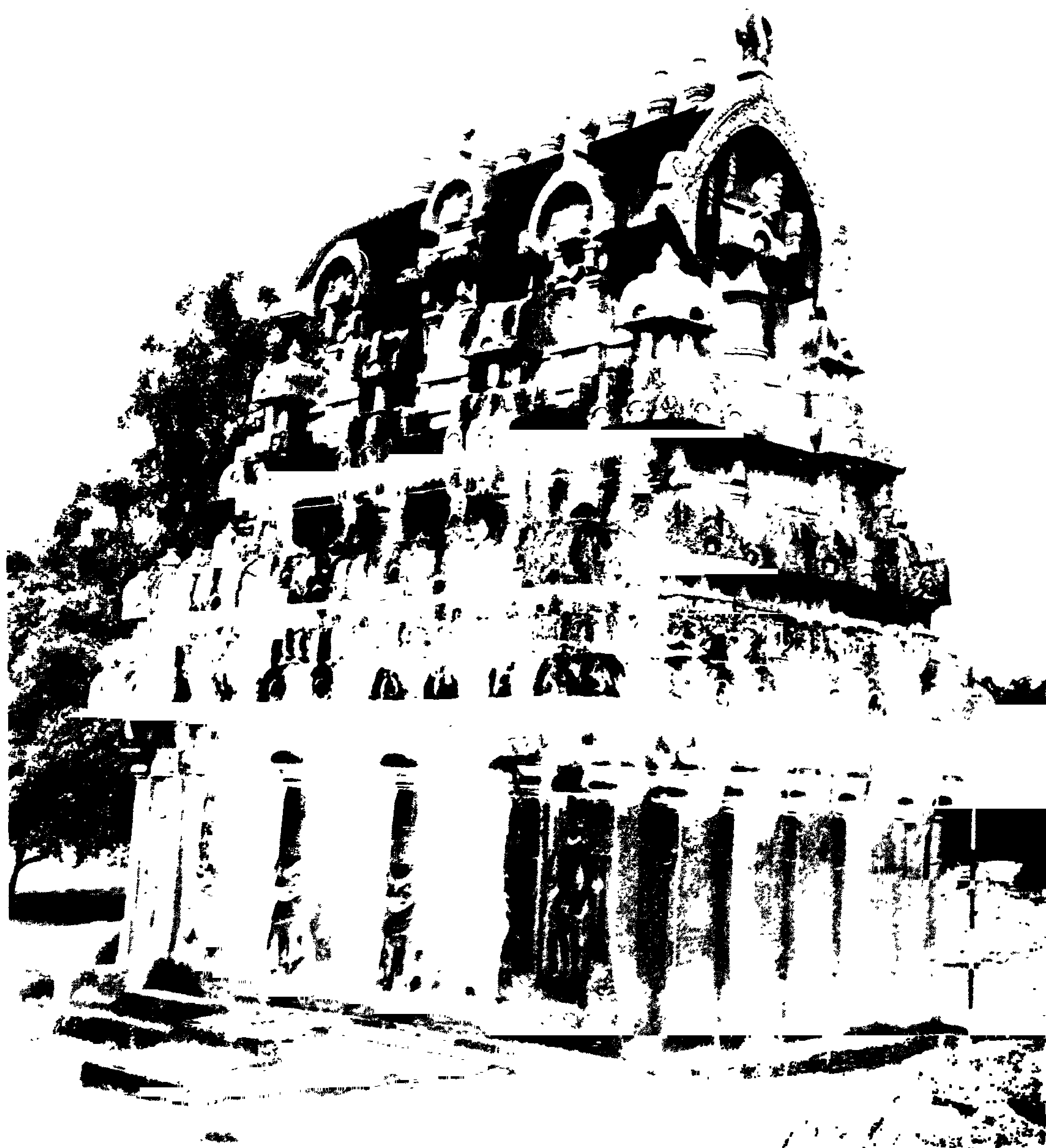
To face pl XLIII



B. *Mahabalipuram: Valaiyankuttai-ratha.* *See page 128*



A. *Mahabalipuram: Dharmarāja-ratha.* *See page 128*



Mahabalipuram: Ganeśa-ratha. See page 128

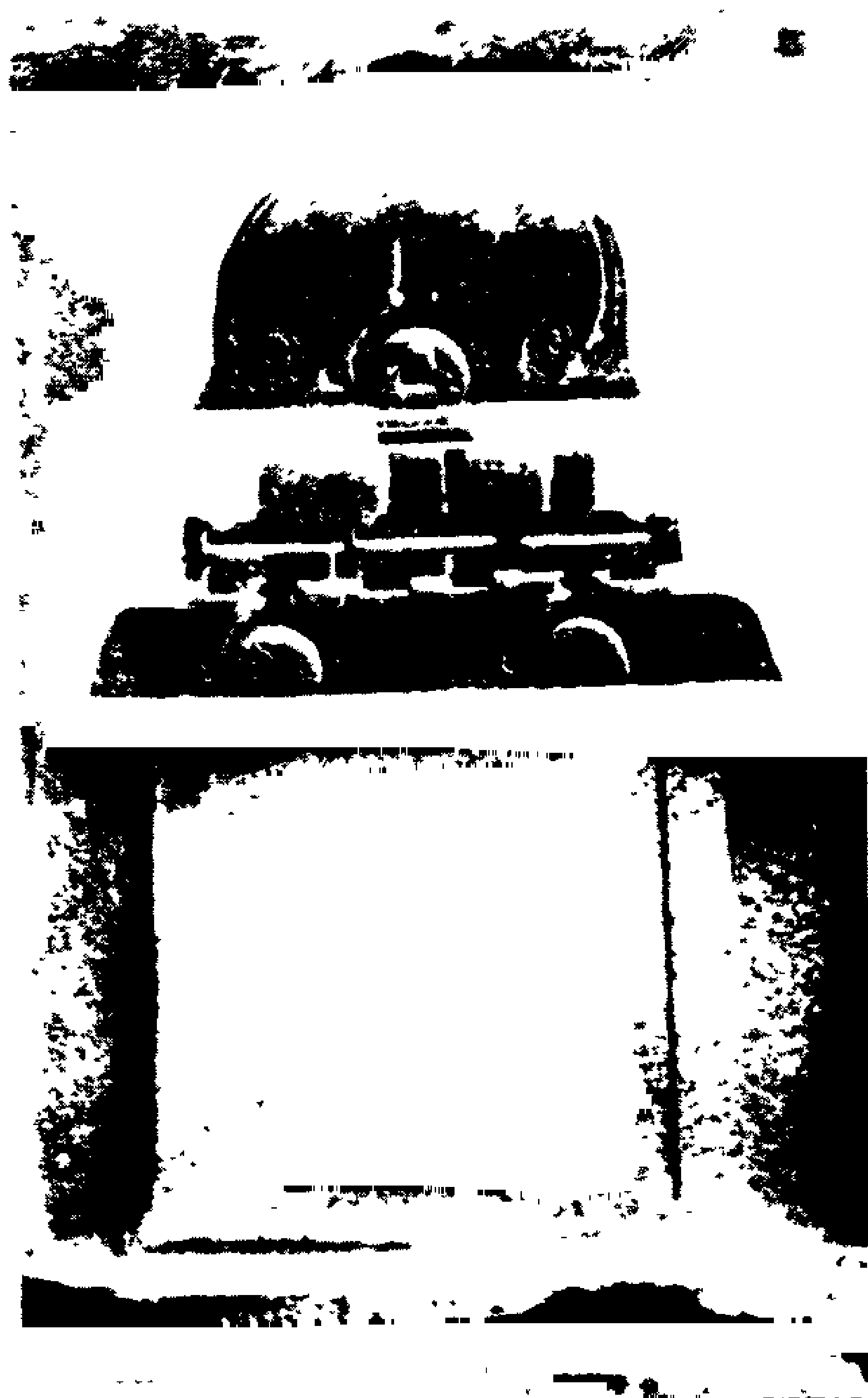
To face pl. XLIV



Mahabalipuram: Trimūrti cave-temple with three shrine-fronts. *See page 123*



A



B



C



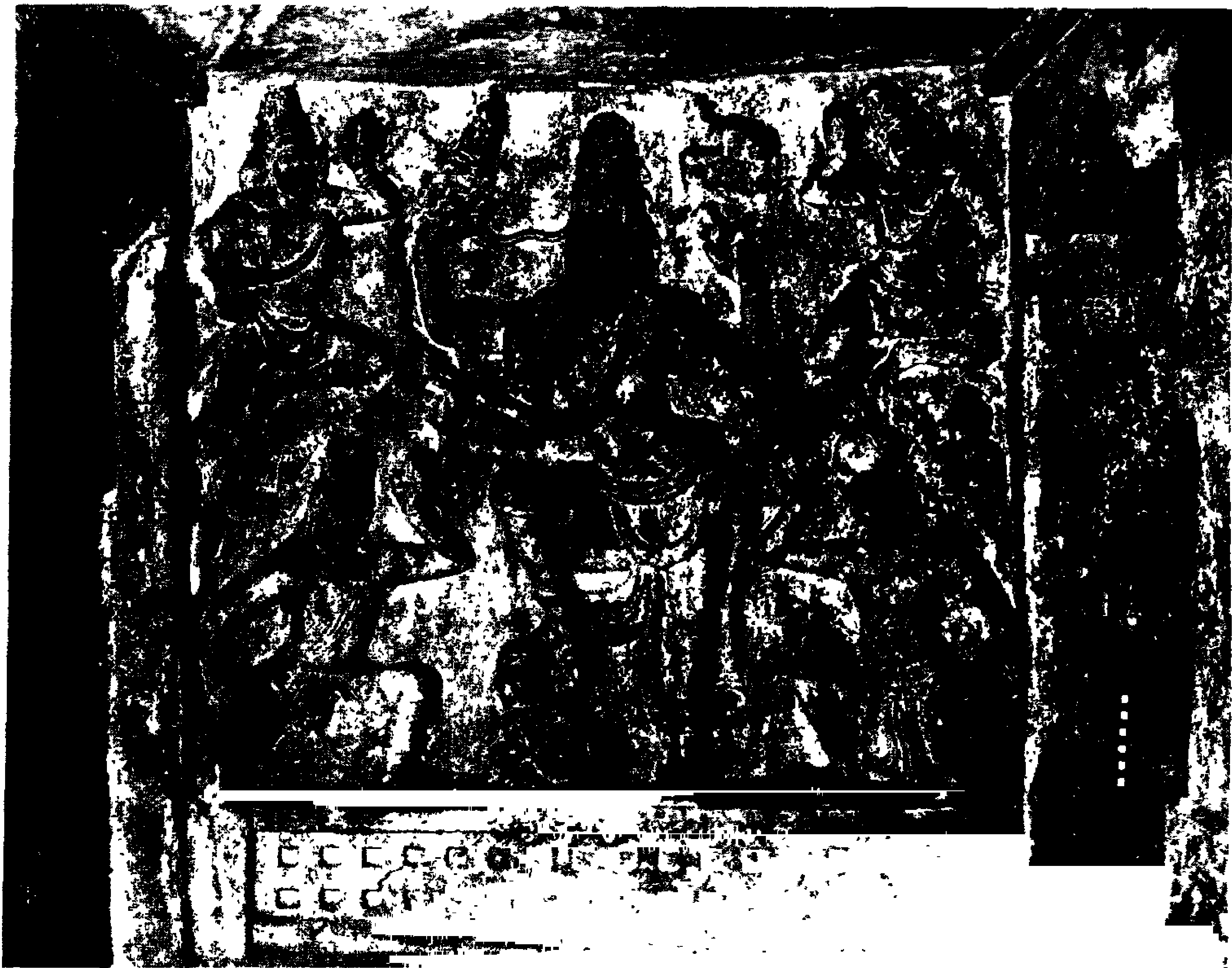
D

Mahabalipuram: models of shrines, A, *Arjuna's Penance,* B, *Rāmānuja-maṇḍapa,* C, *Bhīma-ratha, and* D, *Nakula-Sahadeva ratha.* *See page 128*

To face pl XLVI



Mahabalipuram: general view of rathas. *See page 129*



A. *Tiruchirappalli: Gaṅgāvataraṇa.* *See page 121*

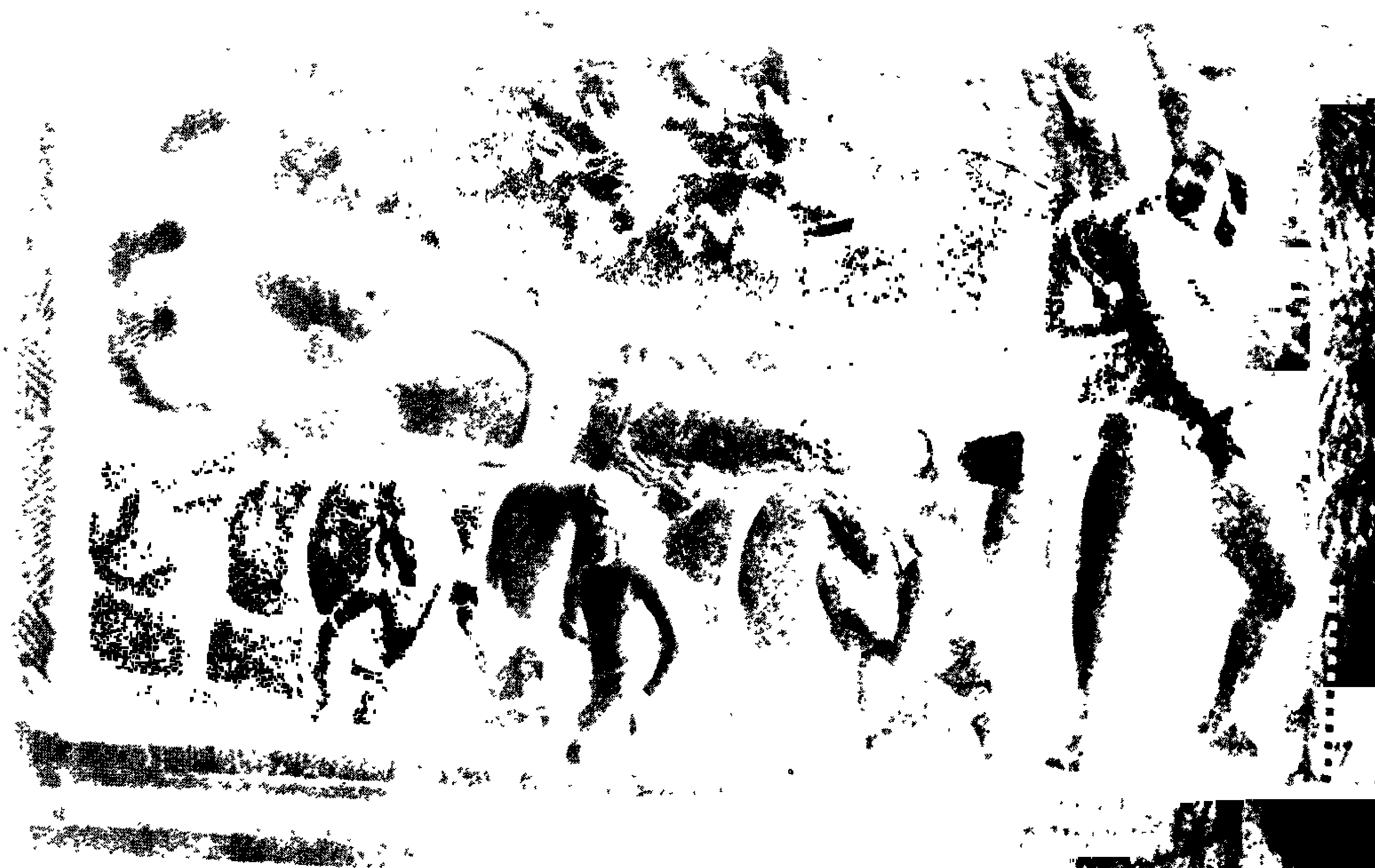


B. *Mahabalipuram: Bhu-Varāha in Varāha-maṇḍapa.* *See page 127*

To face pl XLVIII



Mahabalipuram: Trivikrama in Varāha-maṇḍapa. *See page 127*



A. *Mahabalipuram: Ananta-śāyī Vishṇu in Mahisha-mardinī-maṇḍapa.* *See page 127*



B. *Mahabalipuram: Mahisha-mardinī in Mahisha-mardinī-mandapa.* *See page 127*

To face pl. L



A. *Mahabalipuram: Gaja-lakshmī in Ādivarāha cave-temple.* *See page 127*

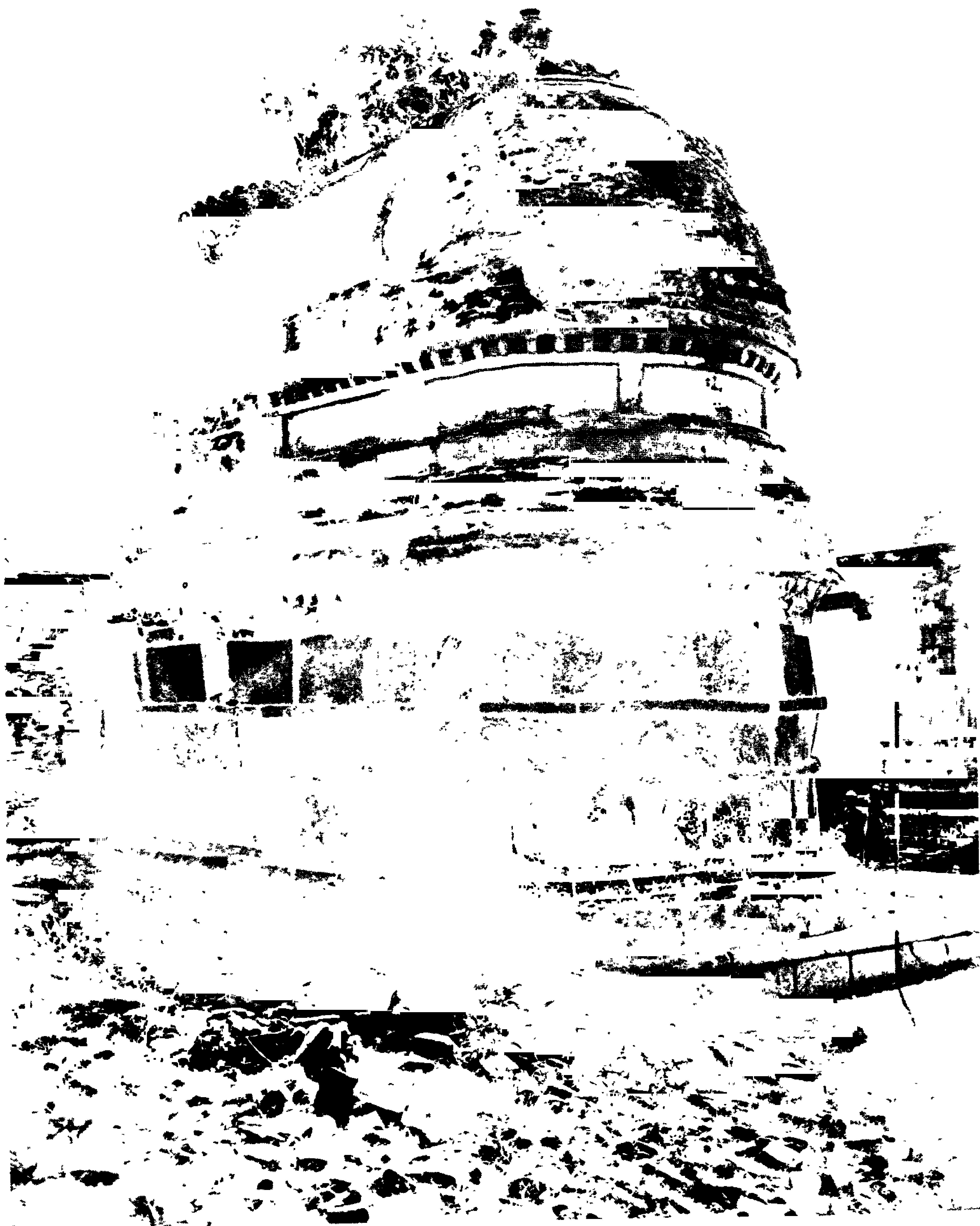


B. *Singavaram: Mahisha-mardinī.* *See page 124*

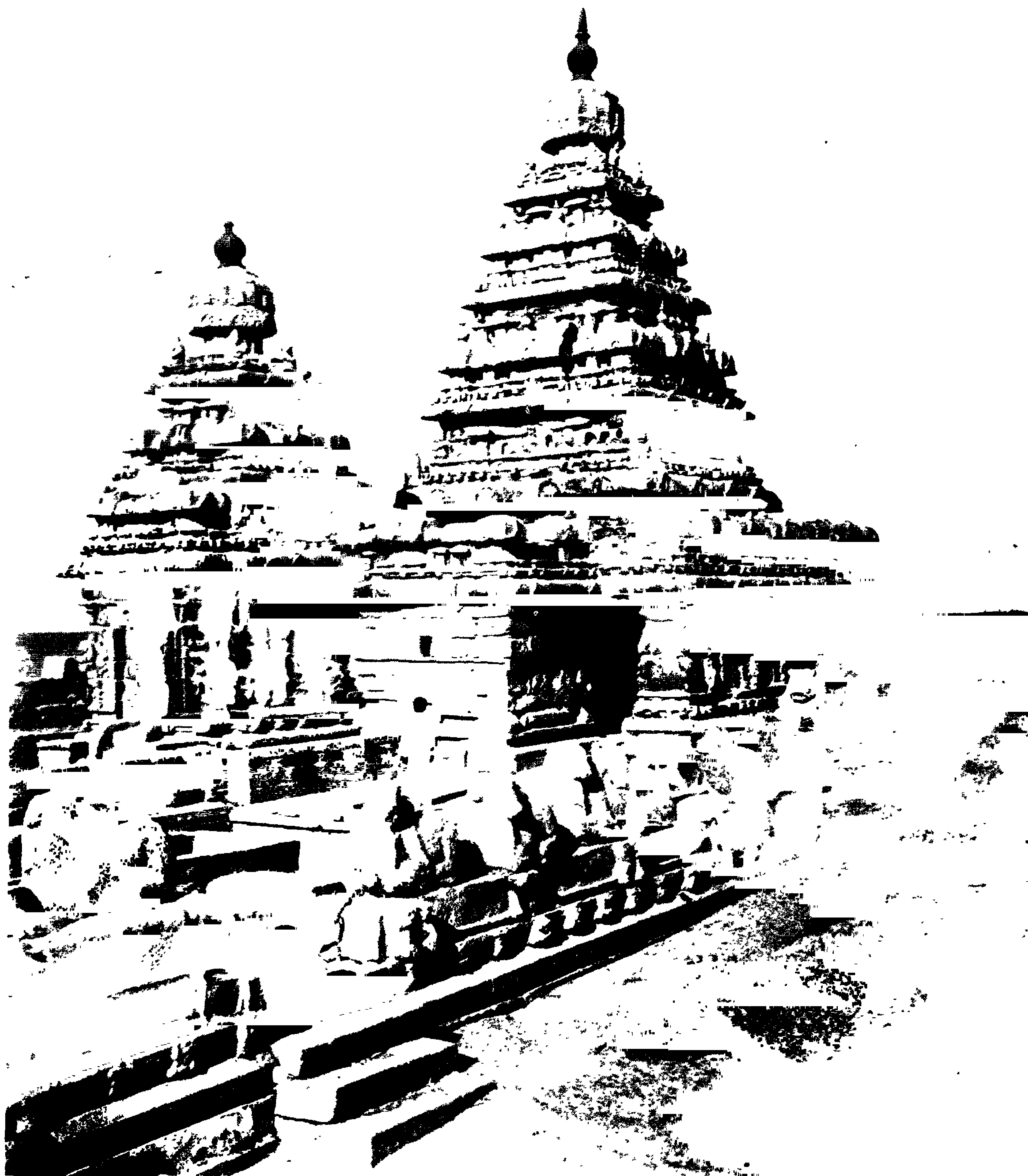
To face pl. LIII



Mahabalipuram: Arjuna's penance. *See page 127*

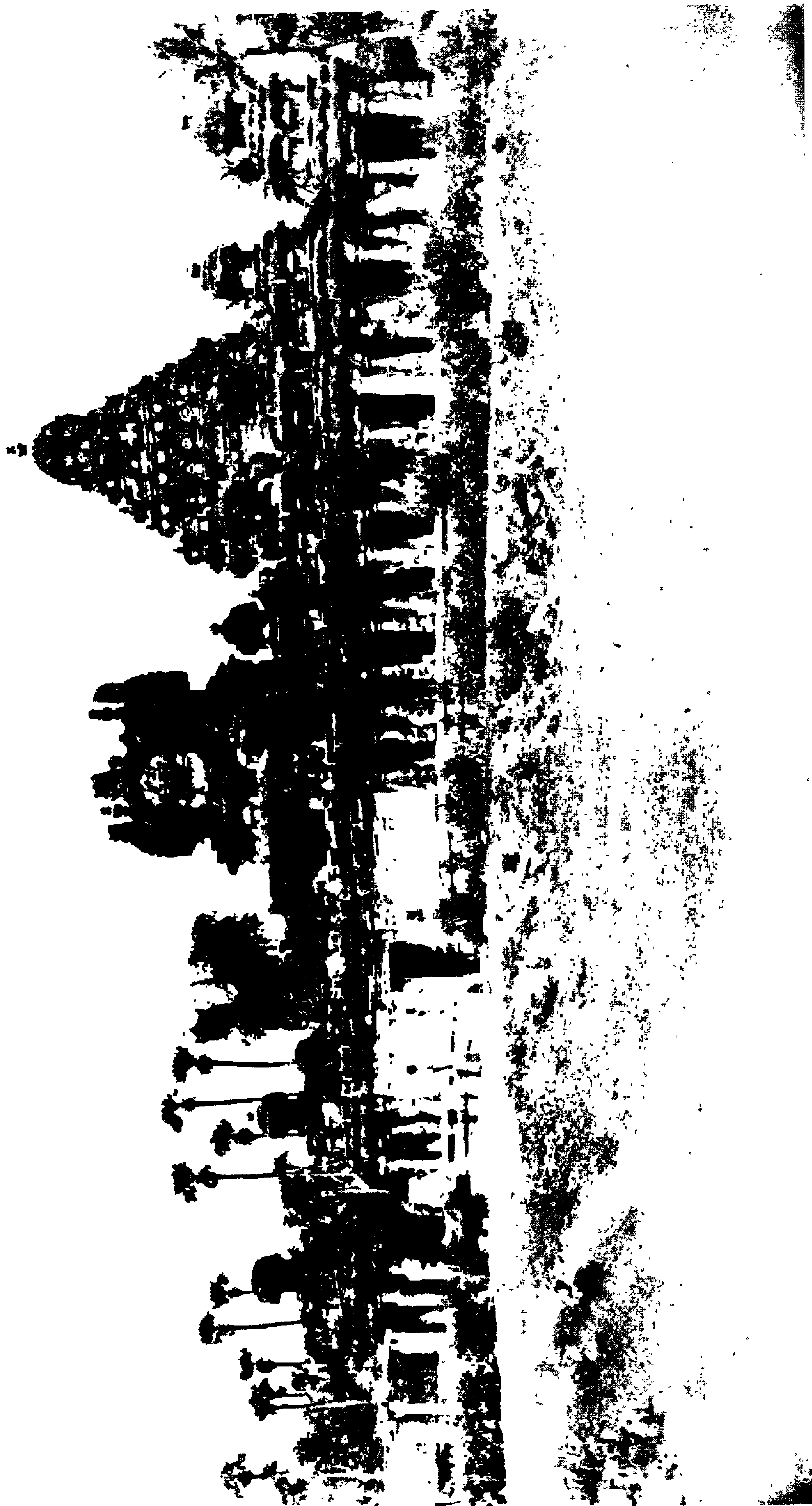


Kalambakkam: Tirunāgēśvara temple. *See page 133*



Mahabalipuram: Shore temple. *See page 133*

To face pl. LIV



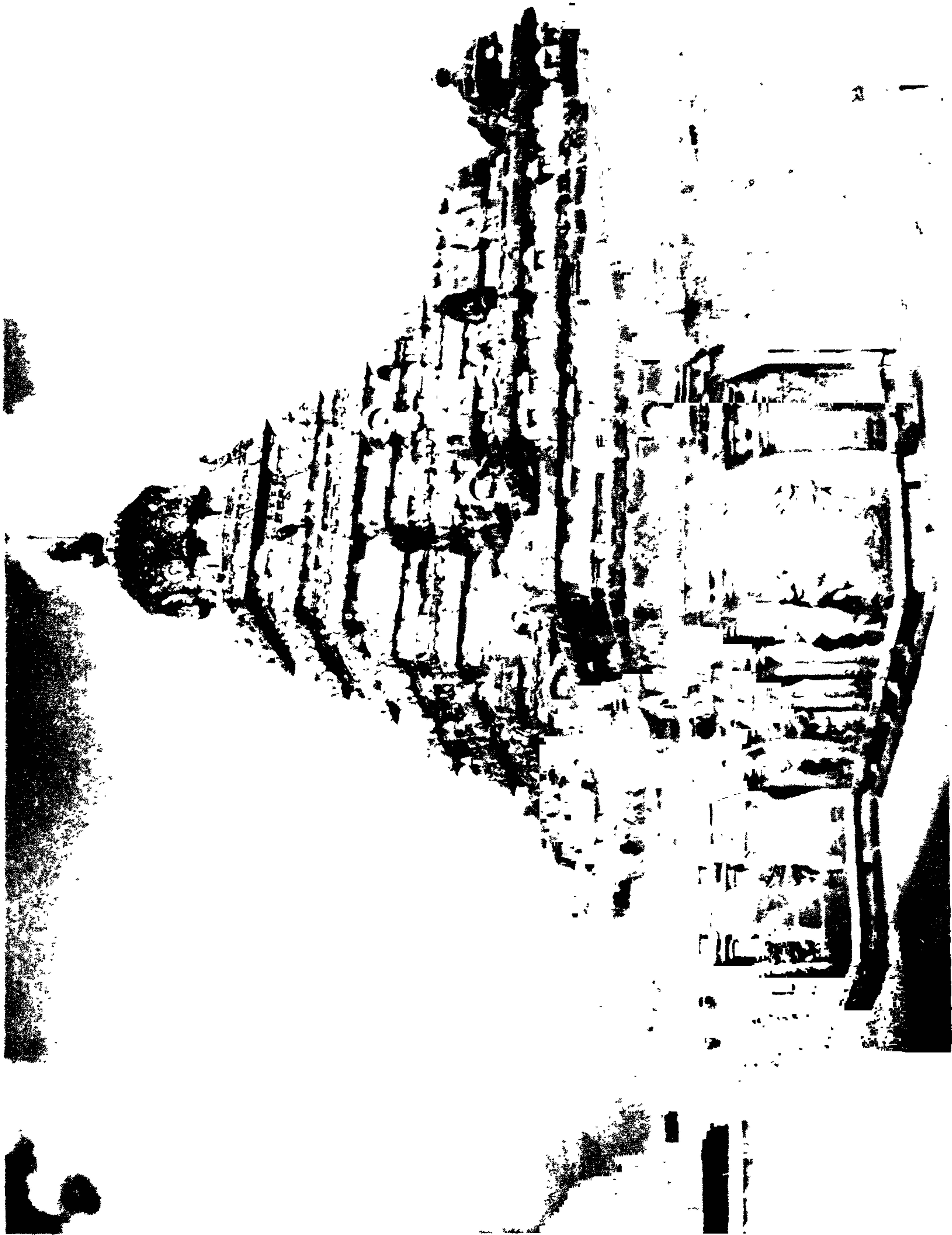
Kanchipuram: Kailāsanātha temple. *See page 133*

To face pl. LVII



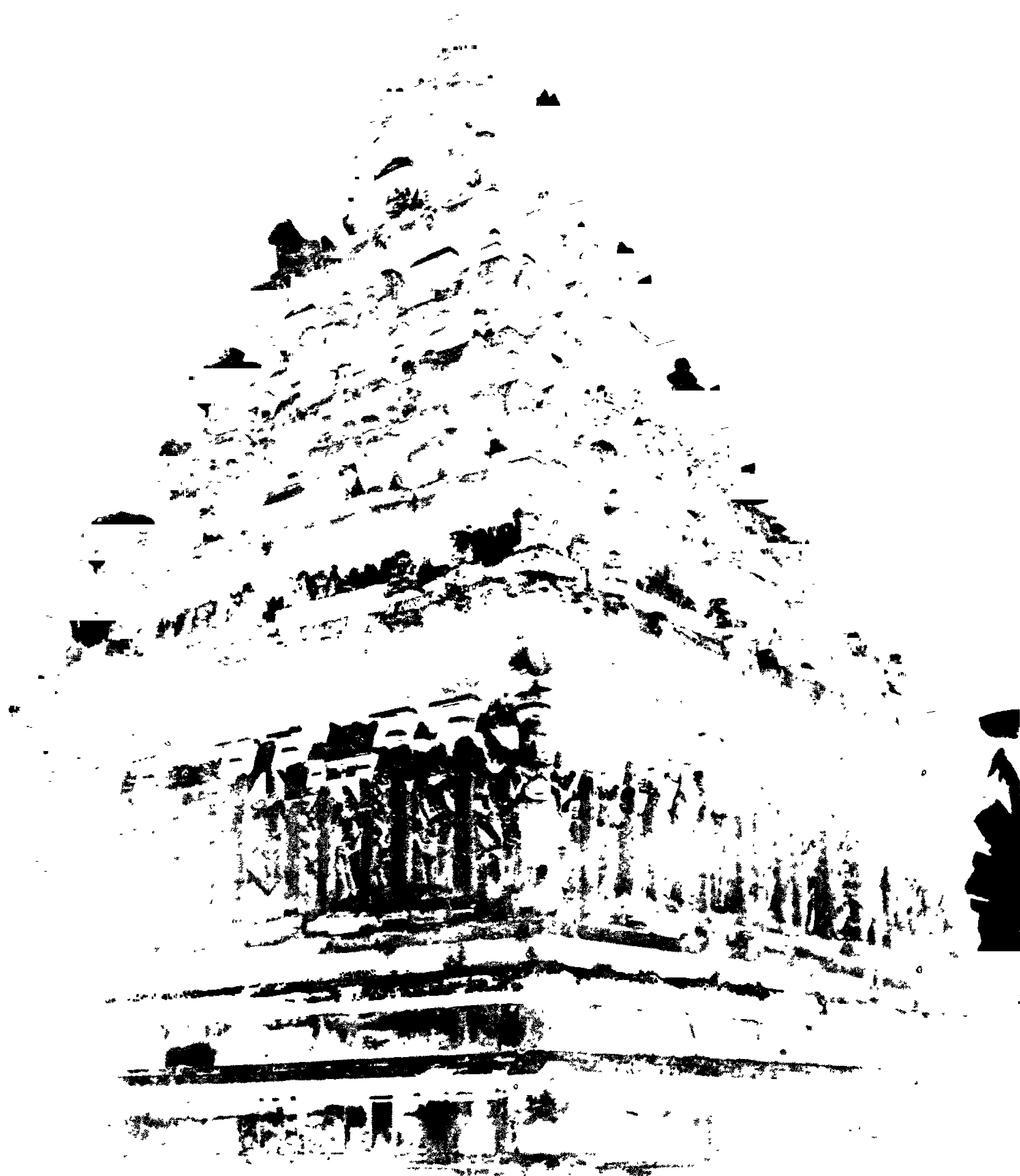
Kanchipuram: Rājasimheśvara and maṇḍapa in Kailāsanātha temple. *See page 134*

To face pl. LVI



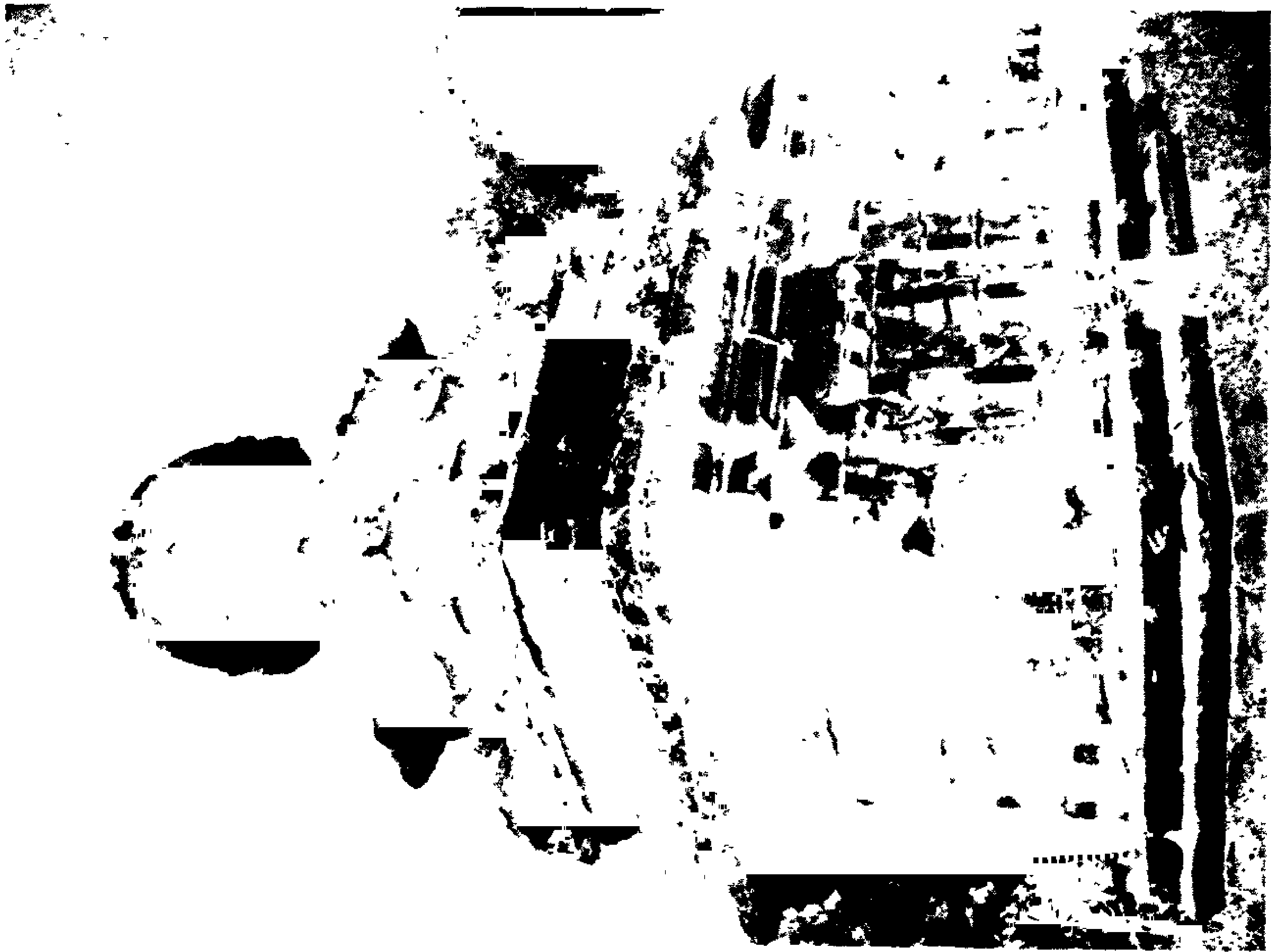
Kanchipuram: Vaikuntha-perumāl temple. *See page 135*

To face pl. LIX



Kanchipuram: Mukteśvara temple. *See page 136*

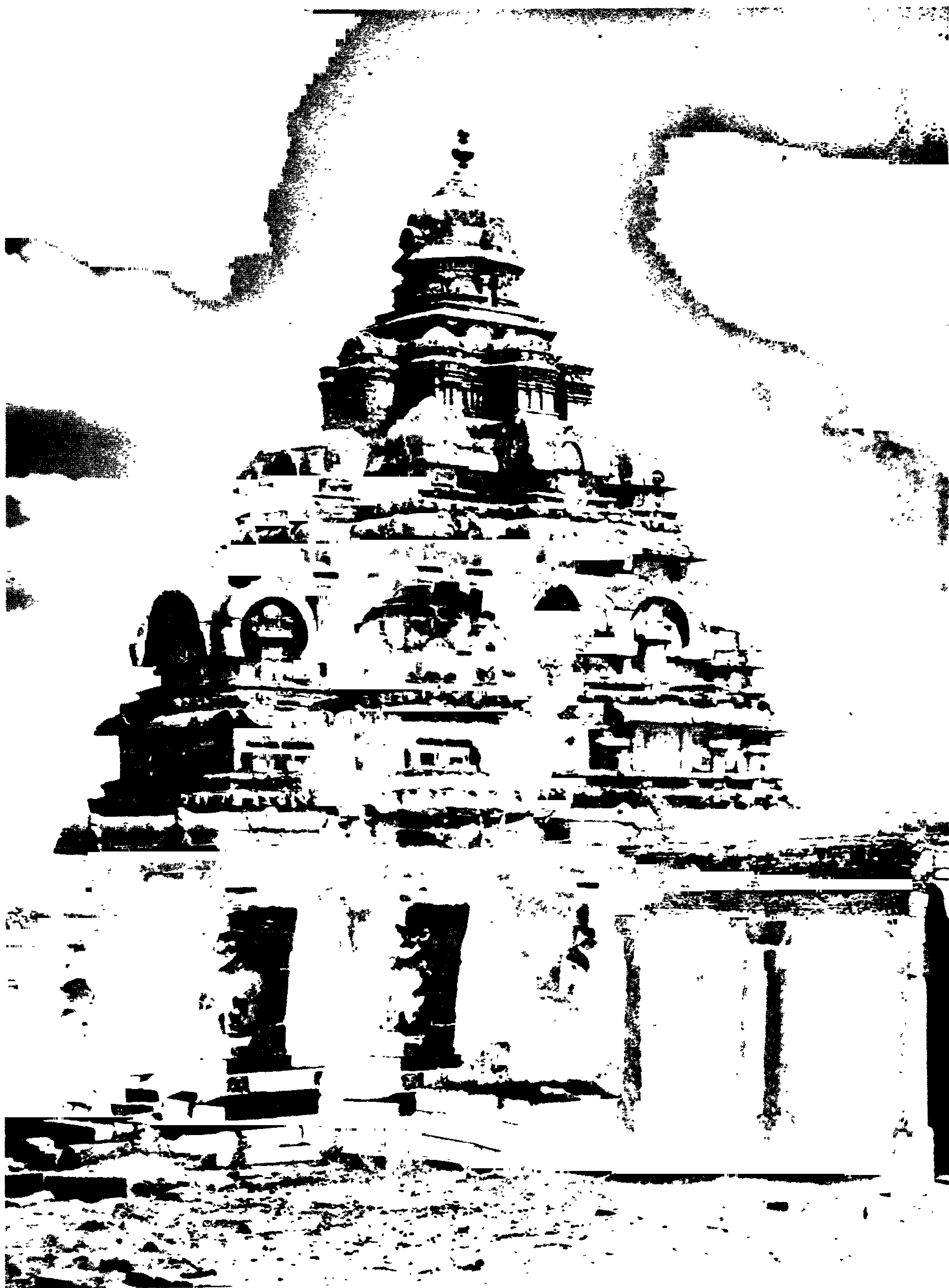
To face pl. LVIII



A. *Kanchipuram: Piravātaneśvara temple.*
See page 136



B. *Mahabalipuram: Mukunda-nāyanār temple.*
See page 136



Panamalai: Tālagirīśvara temple. *See page 137*

To face pl. LX

Three bas-relief miniatures in the Arjuna's Penance (Pl. XLVII A) and Rāmānuja-maṇḍapa (pl. XLVII B) represent the simple *ekatala-vimāna* with all the six *aṅgas*, viz. the *adhishṭhāna* (basement), *pāda* or *bhitti* (pillars or walls), *prastara* (entablature), *grīvā* (neck or clerestory), *śikhara* (roof) and *stūpi* (finial). The three contiguous shrine-fronts of the Trimūrti cave (pl. XLVI) are representations of *dvitala-vimānas*, shown in elevation up to the level of the first storey (ground floor).

The five *rathas* at the southern end of Mahabalipuram (pl. XLVIII) form a group by themselves. Four of them, viz. Draupadī-, Arjuna-, Bhīma- and Dharmarāja-rathas, standing in a north-south line, are carved out of a single whale-back rock cut into three convenient parts. The northernmost part has been utilized for the shorter Draūpadī- and Arjuna-rathas with a common platform or *upapīṭha* below their *adhishṭhānas*, so that their *śikharas* coincide with the top-line of the original rock. The central longer segment has been utilized appropriately for the oblong Bhīma-ratha and the southern taller one with a broader base for the three-storeyed Dharmarāja-ratha. The apsidal Nakula-Sahadeva-ratha and the adjoining sculpture of the elephant have been carved out of another boulder that stood to the west of the main rock. The sculptures of the recumbent bull, with a lion-platform or seat in front, behind the Arjuna-ratha and the standing lion in front of the Draupadī-ratha are carved out of a separate low outcrop on the east and a small tall free-standing boulder on the west respectively.

The Gaṇeśa-ratha (pl. XLV) in the midst of the town is carved out of a boulder on the main hill, and the two Piḍāri-rathas and the Valaiyankuṭṭai-ratha out of free-standing boulders on the western side of the main hill.

Being architectural models, the monoliths reproduce the various types of contemporary structural *vimānas* to the minutest detail of timbering, fastening and metalwork and the decorative designs appropriate to them. These *vimānas* as well as bas-reliefs illustrate the variations in plan, type of *śikharas*, number of *talas* and the *aṅgas*, not to mention other architectural details.

The Draupadī-ratha illustrates the type of a simple hut (*kūṭāgāra*), square on plan, with four of the six *aṅgas* of the *vimāna*, the *aṅgas* that are lacking being the *prastara* and *grīvā* below the *śikhara*. The *ratha* represents the *kūṭa*-type with a domical roof (*śikhara*) crowned by a single *stūpi* or finial, also square on plan (*sama-chaturaśra*), the four-sided *śikhara*, in conformity with the parts below, representing the *Nāgara* order in its pure form. The bas-relief shrines in the Arjuna's Penance sculpture (pl. XLVII A) and on the façade of the Rāmānuja-maṇḍapa (pl. XLVII B) represent the same type. They are more complete *alpa-prāsādas*, in that they have all the six *aṅgas*, including the *prastara* and *grīvā*, the latter being a clerestory raising the roof proper ,over the cella. They are of the same class of *sama-chaturaśra-kūṭas* with the *Nāgara śikhara*, representing the *ekatala* (single-storeyed) variety. The *dvitala* (two-storeyed) variety of the *Nāgara* order is represented by the Valaiyankuṭṭai-ratha and the northern Piḍāri-ratha, square throughout, with the difference that in the latter the *prastara* of the second storey does not carry the *hāra* of miniature shrines as the storey below, while the former has the *hāra* of *śālās* and *karṇa-kūṭas* over both the *talas*.

The southern Piḍāri-ratha and the Arjuna-ratha illustrate examples of *sama-chaturaśra* (square) *vimānas* of the *dvitala* variety with octagonal *śikhara* of the *Drāviḍa* order. They constitute the composite (*miśra*) variety of that order, four-sided from base to *prastara*, including the *talas*, with octagonal *grīvā* and *śikhara*. The Dharmarāja-ratha (pl. XLIV A) illustrates a *tritala* (three-storeyed) example with the same type of *śikhara*, with all the three square *talas* intended to be functional. A pure variety of *Drāviḍa* order, though hexagonal on plan from basement to finial, is perhaps represented by the bas-relief at the front-end of the Nakula-Sahadeva-ratha (pl. XLVII D).

The Bhīma- and Gaṇeśa-rathas illustrate examples of *āyatāśra* (oblong) *vimānas* of the *koshṭha-* or *śālā*-type with wagon-top roofs (*śālā-śikharas*) and with a number of *stūpis* on the ridge, the Bhīma-ratha being an *ekatala* and the Gaṇeśa-ratha a *dvitala* example of the class.

The two miniature shrine-models carved inside either end-arch of the Gaṇeśa-ratha (pl. XLV) illustrate rather tall column-like *vimānas*, circular in section from base to top, representing the pure variety of the *Vesara* order; both are two-storeyed (*dvitala*). The composite variety of that order, i.e. square up to the *prastara* with circular (*vṛitta*) *grīvā* and *śikhara*, is illustrated by the bas-relief models shown at either end of the roof of the Bhīma-ratha (pl. XLVII C).

The apsidal form (*dvyaśra* or two-sided with apse-end) is represented by the Nakula-Sahadeva-ratha. This form, from its resemblance to the back of a standing elephant, as shown in comparison with the adjoining sculpture of an elephant carved, as if for that purpose, is called the *gaja-* or *hasti-pṛishṭha* (*tuṅgānaimōḍam* in Tamil). Because of its elliptical (*vṛittāyata*) shape, though truncated at one end, this is also classed under the *Vesara* order. This *ratha* illustrates a *dvitala-vimāna* of the class.

The *vimānas* with more than one storey carry over the *prastara* of the respective *tala* a string of miniature *vimānas* consisting of: *kūṭas* (miniature *sama-chaturaśra-vimānas*) with domical roof and single *stūpi*), disposed at the corners of the shrine-top and hence called *karṇa-kūṭas*; *śālās*, also called *koshṭhas* (oblong *vimānas* with wagon-top *śikharas* carrying more than one *stūpi*), placed over the sides of the shrine-top; and *pañjaras*, also called *nīḍas* or *nāsikās* (miniature apsidal *vimānas*), coming in between the *kūṭas* and *śālās*. All these are interconnected by lengths of cloisters (*hārāntara*), the entire series forming the *hāra*. While the *karṇa-kūṭas* and cardinal *śālās* (*bhadra-śālā*) are found in all the Mahabalipuram examples, the *pañjaras* are found added to the string only in the case of the Nakula-Sahadeva-ratha and over the *mukha-maṇḍapa* of the first *tala* of the Dharmarāja-ratha. The place of the *pañjara* is taken by sets of smaller pairs (*kshudra-nāsikās*), in the Bhīma-ratha. These *hāras* enclose an ambulatory passage surrounding the central structure of the storey as is found in the Bhīma- and Dharmarāja-rathas, while in the other cases they more or less coalesce with the central structure of the storey (*harmya*), as becomes the rule in the subsequent structural *vimānas*.

The Trimūrti cave-temple (pl. XLVI) is an example of three contiguous but truncated *dvitala-vimānas* shown in their front elevations with the *hāra*-lengths over the *prastara* of the first *tala*, the details of the second *tala* and the other members above not being shown.

The *rathas*, particularly the Arjuna- and Dharmarāja-rathas, contain some of the finest Pallava sculptures. The Draupadī-ratha contains inside the shrine a bas-relief of Durgā cut on the back wall of the sanctum, while the Arjuna-ratha has an empty cell with traces of plaster on the back-wall, showing that the consecrated deity was a painting or stucco relief. The completed top-storey of the Dharmarāja-ratha contains a Somāskanda panel carved by Parameśvaravarman I. The Trimūrti cave-temple contains bas-reliefs of Guru-mūrti, Śiva and Vishṇu in its three shrine-cells. None of the rest, all incomplete, contains any sculpture inside the cell. There is no trace of a rock-cut *liṅga* inside the sanctum of any example, nor is there a water-outlet in the form of projecting spout (*praṇāla*) usually found on the northern side of a shrine. The pillars, shown mostly as pilasters, are complete with capitals, and the corbels are of the *taraṅga* variety. Lion- or *vyāla*-based pillars or pilasters are found in front of the *ardha-maṇḍapas* of the Dharmarāja-, Bhīma-, Arjuna- and Nakula-Sahadeva-rathas, the last-mentioned having in addition a pair of elephant-based pilasters.

Bhitti-toraṇas or *makara-toraṇas* on pilasters, spanning entrances or enclosing niches (*deva-koshṭhas*) are found in the Draupadī-ratha, Valaiyankuṭṭai-ratha and in the northern Piḍāri-ratha. The *kūḍu*-arches are also fully formed in the *kapotas* of the various *talas*.

4. STRUCTURAL TEMPLES

While Mahendra's Mandagappattu inscription (above, p. 116) indicates that the contemporary structural temples were built of the traditional material—brick, timber, metal and mortar—that king, in addition to excavating a temple with *maṇḍapa* and shrine into hard rock at Mandagappattu, followed by others in various places, seems to have also brought into use stone pillars fashioned out of the local hard stones in structural *maṇḍapas* attached to brick and timber shrines. These *maṇḍapas*, primarily built of brick, had stone pillars inside covered by stone slabs overlaid with brick and mortar terrace.[1] Such *maṇḍapas* with stone pillars and slab-roofing or with timber beams and tiled roofing are common among the temples in the Kanara and Malabar areas on the west coast. This was perhaps after similar *maṇḍapas* with the Palnad limestone pillars constructed by the Ikshvākus at Nagarjunakonda.[2] This is to be inferred from a few pillars with top and bottom *śadurams* and the intervening *kaṭṭu*, one with embossed lotus-medallions and another inscribed with the *birudas* of Mahendravarman, found incorporated into a ruined *maṇḍapa* in the third *prākāra* of the Ekāmranātha temple at Kanchi.[3] As *maṇḍapa*-pillars, they could not have formed part of a shrine or *vimāna*. Similar *maṇḍapa*-pillars, with top and bottom *śadurams* and intermediate bevelling, i.e. with rectilinear cuts, and with inscriptions of Narasiṁha-varman I Māmalla, have come to light in Sivanvayal and Kuram.[4] Again, similar pillars of hard stone are found used in the *maṇḍapa* in front of the Rājasiṁheśvara (Kailāsanātha) built by Rājasiṁha at Kanchi, the inscription of Vikramāditya referring to his invasion of Kanchi being found on one of them.[5] This oblong *maṇḍapa* was originally open in the middle of all it four sides, the corners covered up by walls of sandstone, the longer eastern and western façades having two pillars and two pilasters and the shorter northern and southern façades two pilasters each. In addition, there are two rows, with four pillars in each, inside the *maṇḍapa*. These inner pillars as well as those on the western façade are of granite, while the rest are of sandstone. That the granite pillars cannot be later insertions in place of the worn-out original members is proved by a contemporary Chāḷukyan inscription on one of them. They are moulded with *śadurams* and *kaṭṭu*, but in all cases, the capitals carried by the pillars, viz. the *padma* and *phalaka*, are carved out of sandstone blocks. Since in all the columns, whether sandstone or granite, the large capitals are moulded out of sandstone, the indication would be that the Pallava masons, even at this stage, could not quarry large blocks of granite or gneiss and make heavy and complicated mouldings in the round, involving curvatures, out of the hard material. They could only

[1] The technique of stripping gneiss or granite slabs from rock surfaces was known from the megalithic times, as they were widely used in the construction of dolmens and cists.

[2] A. H. Longhurst, *The Buddhist Antiquities of Nagarjunakonda, Madras Presidency*, Mem. Arch. Surv. Ind., no. 54 (Delhi, 1938), p. 11.

[3] *South Indian Inscriptions*, XII (1943), no. 14. Even this *maṇḍapa* has been pulled down recently, and the pillars are scattered amidst the débris.

[4] 'The Sivanvayal inscription', *Epigraphia Indica*, XXVII (1947-48), p. 59; *South Indian Inscriptions*, VII (1933), no. 42. Evidently the Kuram pillar formed part of the community *maṇḍapa* referred to in the Kuram plates of Parameśvaravarman, *ibid.*, I (1890), no. 151, pp. 61-62, and not of the Kuram temple built by the same ruler.

[5] *Epigraphia Indica*, III (1894-95), pp. 359 ff.

cut straight faces or bevels and carve shallow reliefs, like lotus-medallions, in columnar blocks of hard stone, perhaps shaped out of free-standing pillar-like natural rocks, which are abundantly found, while they could also show all the mouldings, relieved and *in situ*, in their cave-temples and *rathas* on rock-walls. Even the sandstone pillars and pilasters have a uniform four-sided section throughout (perhaps the masons were not quite sure of the strength of the columns with sections reduced by bevelling), and the pilasters have rearing lions carved in their front adding to their mass. Similar *maṇḍapa*-pillars with Rājasiṁha's inscriptions are found in Vayalur and Tirupporur[1] built into later *maṇḍapas*. It is clear that none of these pillars formed part of a structural *vimāna* or shrine proper. It is only in later Pallava times that pillars complete with capitals, and sometimes with lion-bases, all of granite quarried fresh, are found to have been made for the *maṇḍapas*. Stones derived by the firing method were considered to be unfit for use as pillars and beams, while slabs so obtained were used for pavements and ceilings.

As mentioned earlier (above, p. 118), it was at the time of Parameśvaravarman I (672-700) that attempts to construct structural *vimānas* with stone as the building material appear to have been made in Pallava history. Among the few extant examples of such buildings is to be found for the first time the use of entire granite slabs cleaved by the traditional firing method either in a dolmenoid fashion or as coursed work corresponding to the various mouldings provided by laying them flat or by setting them on edge wherever vertical courses such as *kaṇṭha*, etc., came in.

The central shrine of the Vedagirīśvara temple on the summit of the hillock in Tirukkalukkunram is built of three huge slabs of stone forming its inner walls with a roof-slab on top. Externally, these dolmenoid orthostats are cased at present by the moulded stonework of later Choḷa times. Internally, the inner surfaces of the three slabs enclosing the cella have on them the characteristic bas-relief sculptures of Somāskanda on the back-wall and Dakshiṇā-mūrti, Nandin, Chaṇḍikeśvara etc., on the other walls, indicating the period of Parameśvara. This dolmenoid structure evidently replaced the brick-and-mortar *mūla-sthāna* temple of Skandaśishya Pallava, an early ancestor referred to in Māmalla's inscription in the cave-temple below on the same hill.[2] When Parameśvara constructed this temple, the exterior of the slab-walls probably showed reliefs of pilasters, etc., the mouldings of the basement, as also perhaps the superstructure of the *vimāna* over the top slab, being supplied by brickwork. Such constructions are known among the early temples of the Chāḷukyas also, who used slabs of sandstone in place of granite, a material which they always preferred.

The apsidal Śiva temple at Kuram, the construction of which by Parameśvaravarman I is confirmed by the Kuram plates,[3] is an example of the second type. Here, granite slabs of a thickness varying from 4 to 9 in. are used in courses with some of the mouldings, such as the octagonal *kumuda* composed of two or three tiers. The lowermost moulding or *upāna* is formed of flat slabs made to rest over a brick platform, and the next vertical *jagatī*-moulding is formed by a line of narrow slabs set on edge. The *kumuda* again, with its three faces, is made up of a central flat slab with a straight edge and upper and lower slabs with bevelled outer edges in order to give the appearance of a *tripaṭṭa-kumuda* (segment of an octagon). The *kaṇṭha*, which is a recessed vertical member, is again a line of vertical narrow slabs, and the *paṭṭikā* or topmost member of the plinth, forming the floor of the shrine, is of wide slabs placed flat with the edges suitably projected. The walls above

[1] *South Indian Inscriptions*, XII (1943), nos. 26 and 27.
[2] *An. Rep. South Indian Epigraphy*, 1909, pt. II, para. 15; *ibid.*, 1932-33, pt. II, para. 3.
[3] *South Indian Inscriptions*, I (1890), no. 151.

are composed of an alternating series of vertical and horizontal slabs, the vertical slabs placed longitudinal and transverse, the box-like cavities so formed being filled up with brickwork. The Kuram plates themselves mention the land acquired for a brick-kiln for burning the bricks used in the construction of this temple, which is therein called *Vidyā-vinīta-Pallaveśvara*. While the wall-portions of this temple have collapsed, as also those of its *ardha-maṇḍapa*, they are still extant in another temple of the same type at Kalambakkam (pl. LIV) and illustrate very well the method of construction. An inscription from Sirrambakkam[1] refers to the construction of a temple, perhaps one of the two types mentioned above, in the very first year of Parameśvaravarman.

However, these methods, which obviously did not conduce much to the stability of the structure or facility of carving bas-reliefs and, furthermore, were not suitable for the erection of large ambitious structures, were abandoned by Narasiṁhavarman II Rājasiṁha (695-722), another great builder, who succeeded Parameśvara. In his constructions he reverted to the soft stones such as the sandstone available in and around Toṇḍaimaṇḍalam. It is this coarse and greyish or yellowish variety of sandstone that was quarried in blocks and brought to the site of work, where they were cut, carved or moulded for the construction of many fine temples, such as the Kailāsanātha (pl. LVI) and other temples of Rājasiṁha and his successors in Kanchi, the Shore temple (pl. LV) and the Olakkaṇṇeśvara temple at Mahabalipuram and similar temples elsewhere. Even in the construction of these temples, the desire for the incorporation of the novel material—granite—at least as slabs in courses where such flat slabs could be used with advantage and where strength also was required, is clearly noticeable: granite is found to be always used in the *upāna* or the lowermost moulding and the *paṭṭikā* or the topmost moulding of the *adhishṭhāna*, where the slabs could be laid flat as a bedding for the former course and as the flooring of the shrine or the top of the platform which the latter course represents. Rājasiṁha and his son Mahendravarman III (720-28) used such slabs in the Kailāsanātha temple-complex for these two courses, the rest being of sandstone, as also Nandivarman II Pallavamalla (731-96) in his *magnum opus*, the Vaikuṇṭha-perumāḷ temple at Kanchi. It is on the edge-faces of these granite slabs that inscriptions are found to be engraved in preference to the sandstone faces, where they would weather away sooner. Though the soft stones, ranging from coarse to almost fine in texture, could be easily carved or sculptured into bas-reliefs to perfection in their fresh condition, it was soon found necessary to protect them from the action of wind and weather by thin plaster, which was further embellished by painting. Even in the temples built of soft stones, the individual sculptures could not be carved out of the faces of single stones, as such stones or blocks forming the courses were small; nor were they carved over the faces of single larger slabs and fitted into appropriate positions, as we find in the later temples from the time of Dantivarman (796-846). On the contrary, they were made as composite carvings extending over the contiguous faces of more than one stone that constituted the masonry-courses. Thus, the blocks which were to carry the bas-reliefs were built into position with their lateral, top and bottom faces trimmed neat to enable fitting, as in ashlar work, while their outer faces were left unfinished so that the appropriate parts of the sculpture could be carved out *in situ*. The fitting of stones in the courses, therefore, had to be very close and accurate to enable the continuity of the sculptures. However, the resultant bas-reliefs were rather shallow or flat, and their features had to be heightened to a larger extent by plaster and paint.

The complex of three shrines with accessory *maṇḍapas* and enclosures, familiarly called the Shore temple (pl. LV), at Mahabalipuram is in part perhaps an early essay of Rājasiṁha

[1] *An. Rep. Ind. Epigraphy*, 1947-48, no. 83.

in building a large temple-complex. Of the three shrines, the largest, which is a complete Śaivite *vimāna*, is called Kshatriyasiṁheśvara (Kshatriyasiṁha being a title of Rājasiṁha) facing east towards the sea. The smaller *vimāna* called Rājasiṁheśvara, likewise dedicated to Śiva, faces west. In between the two is a shrine, without any pyramidal superstructure, containing a rock-cut reclining Vishṇu or Ananta-śāyin. The living rock that contains the sculpture constitutes also partly the moulded basement of the two contiguous shrines, viz. the Vishṇu shrine and the western Śiva shrine, showing that they were coeval. The larger *vimāna*, however, was a subsequent addition in front. The Vishṇu shrine is a truncated *vimāna* of the oblong type (*āyatāśra*) with a *mukha-maṇḍapa* in front. The western Śiva temple is an example of a *sama-chaturaśra-tritala-vimāna*, which is sunk to a certain extent into the northern half of the hind wall of the Vishṇu shrine, since the *adhishṭhānas* of both the shrines at this part are cut out of the rock and built up on the other sides. The eastern *vimāna* stands at a slightly higher level and is a *sama-chaturaśra-chatushtala-vimāna*, which is made to look like a five-storeyed structure by a close *prākāra*-wall, of lesser height than the first storey, surrounding the *garbha-gṛiha* and carrying on the top a *hāra* of *kūṭas* and *śālās*. The two *vimānas* derive their apparent height and slenderness by the absence of a *hāra* in the first and the fourth storey of the larger *vimāna* and in the top storey of the smaller *vimāna* and the relatively greater heights of the *harmyas*. In both these *vimānas* granite slabs are used for the *upāna* and *paṭṭikā*, while the *stūpi* is of polished blackstone and is octagonal, like the *śikharas* below, making both the *vimānas* conform to the *Drāviḍa* order. The pillars, with rampant lions characteristic of Rājasiṁha, are the most common, while there are also pillars where, in place of the lion or *vyāla*, elephants, *bhūtas*, *nāgas*, rams, etc., are substituted. Both the Śiva shrines contain Somāskanda panels inside and *dhārā-liṅgas* of black polished stone. In the absence of the *hāra* in some of the storeys, these two *vimānas* resemble the northern Piḍāri-ratha (above, p. 129).

The Kailāsanātha temple (pl. LVI), the largest Pallava temple-complex also built by Rājasiṁha and his son Mahendra, shows some advances. The main *vimāna* (pl. LVII) is a large *chatushtala-vimāna*, essentially *sama-chaturaśra*, with an octagonal *Drāviḍa śikhara*, having sub-shrines integrated, as it were, not only on the three cardinal sides (as in the case of the Panamalai temple, pl. LXI) but also at the four corners with an *ardha-maṇḍapa* or *antarāla* on the eastern side in place of the attached shrine; the *adhishṭhāna* carrying these is projected accordingly at the cardinal sides and at the corners. The cardinal shrines are oblong and the corner-shrines square on plan in conformity with the system of *bhadra-śālās* and *karṇa-kūṭas*, the *bhadra-śālā* of the eastern side functioning as the *antarāla*, while the rest are *parivāra*-shrines. Further, it is an example of a *sāndāra-prāsāda* in that its *garbha-gṛiha* or cella is surrounded by two walls, thus enclosing an inner closed ambulatory. This double walling is a practical device for raising the height of the *vimāna*, since the two walls, extended upwards by corbelling (*kadalikā-karaṇa*—stepped in by successive layers ultimately to meet each other on top), would afford a higher and stronger base for the upper *talas* of the *vimāna*. The upper *talas* have *hāras* of *kūṭas*, *koshṭhas* and *pañjaras*. Of the seven shrines that surround the main shrine externally, the two at the front corners and the two lateral ones face east like the main shrine, while the three shrines at the hind-corners and the hind-side face west. They all contain bas-relief figures of Śiva in different forms, while inside the central shrine there is a Somāskanda panel on the back-wall and a *dhārā-liṅga* at the centre of the floor. In front of the central shrine, separated from it by an open court (now occupied by a modern *maṇḍapa*), is an oblong, pillared *maṇḍapa* with granite and sandstone pillars and pilasters carrying sandstone capitals (pl. LVII). It is this *maṇḍapa* that contains the inscription of Chāḷukya Vikramāditya mentioned above (p. 131) and other early Chola inscriptions. Surrounding the main *vimāna* and the *maṇḍapa* is a string of fiftyeight shrines abutting

on the compound-wall, which has a small *gopura*-entrance at the centre of its length on the western side-wall. On the eastern side, the place of the *gopura* is taken by a large oblong (*āyatāśra*) *dvitala-vimāna* with a *śālā-śikhara* and with a *mukha-maṇḍapa* in front facing east. This *vimāna* differs from the main *vimāna* in being oblong like a *gopura* with *śālā-śikhara* and in not having *hāras* of *kuṭas*, *koshṭhas* or *pañjaras*, even over the first storey (or ground floor). It also contains a Somāskanda panel and a *dhārā-liṅga*. It is on either side of this *vimāna*, built by Mahendravarman III, that two entrances to the court surrounding the main shrine and the *maṇḍapa* and enclosed by the fiftyeight sub-shrines are provided. All the sub-shrines forming the cloister round the main *vimāna* (Rājasiṁheśvara or Kailāsanātha), except two, are *sama-chaturaśra-dvitala-vimānas* with *śikharas* of the *Drāviḍa* order; the two exceptions are those coming respectively opposite the southern and northern *bhadra-śālās* of the main *vimāna*: they are of the *śālā*-type simulating in external appearances the western *gopura*, but enshrine inside bas-reliefs of Vishṇu and Brahmā. All the *vimāna*-fronts have cantoning *vyāla* or *gaja-vyāla* pillars. The space in front of the Mahendravarmeśvara is enclosed by a square *prākāra*, again with a small *gopura* in front, and two lateral openings, now closed, the *prākāra*-walls filled with profuse bas-relief sculptures on their inner faces facing the court. In front of this outer court stands in a north-south line a row of eight independent dedicatory shrines, all *sama-chaturaśra-dvitala-vimānas* with *Drāviḍa-śikharas* and attached *mukha-maṇḍapas* in front and containing inside bas-reliefs of Somāskanda and other sculptures on their outer walls. Three of them are disposed to the south of the outer *gopura*, and the remaining five are situated to the north of it. That they are dedicatory or memorial shrines is indicated by the names, such as Nityavinīteśvara, contained in the inscriptions that some of them carry.[1] One of them was clearly built by Raṅgapatākā,[2] the favourite queen of Rājasiṁha, while another was built by a second queen whose name is lost.[3] The front pillars of the *mukha-maṇḍapas* of these shrines are *vyāla*- or *gajavyāla*-based, the two types alternating in the shrines. This temple-complex would thus show three phases of development: the initial phase, consisting of the main *vimāna* and the pillared *maṇḍapa* (pl. LVII), was the work of Rājasiṁha; the second phase, the enclosure round the *vimāna* and *maṇḍapa* with the Mahendravarmeśvara in front and a *gopura* behind and fiftyeight small shrines all round, was that of Mahendra, son of Rājasiṁha, who did not, however, survive his father; the third phase, indicated by the outer court built in front of the Mahendravarmeśvara with the small *gopura*, belongs to a period immediately after the time of Rājasiṁha. The dedicatory shrines were contemporary with the two earlier groups.

The Vaikuṇṭha-perumāḷ temple (pl. LVIII), built by Nandivarman Pallavamalla and dedicated to Vishṇu, is the next important Pallava temple in the series, since it is a large temple with a peculiar plan. It is a *sama-chaturaśra-chatushtala-vimāna*, a *prāsāda* of the *sāndāra* type, in that the lower storeys have enclosed circumambulatories between the outer and inner walls (*bāhya*- and *antara-bhittis*). The ground floor is again surrounded by a pillared cloister, the outer wall of which is of lesser height than the first storey (ground floor) and carries like the three lower storeys of the main *vimāna*, a *hāra* of *kūṭas* and *śālās*, but not the *pañjaras* found in the *hāras* of the main *vimāna*. Of the four storeys, the three lower ones are functional, as they contain one or the other of the three forms of Vishṇu, standing, sitting or reclining, and each is a shrine with a *mukha-maṇḍapa* made accessible by flights of steps constructed suitably in the space between the walls. In design, it is essentially a system of three walls of increasing heights built one behind the other on each side,

[1] *South Indian Inscriptions*, I (1890), no. 28.
[2] *Ibid.*, no. 29.
[3] *Ibid.*, no. 30.

the innermost wall really enclosing the three superposed cells separated horizontally from each other by terraces. Thus, the lowermost storey or first *tala* has a *garbha-gṛiha* surrounded by two closed ambulatories with an open ambulatory outside formed by the enclosure-wall making in all three *prākāras* or ambulatories. The second storey has two circumambulatories, the inner one closed and the outer one open, while the third *tala* has a single open ambulatory. The fourth *tala*, of lesser dimensions, mounted on the top of the third storey, is non-functional and is closed on all sides; it carries a *grīvā* and an octagonal *śikhara* over it. In addition to the usual sculptures and inscriptions, the most interesting content of this temple is the series of panelled sculptures narrating the history of the Pallavas from their putative ancestry to the time of Nandivarman II, the founder of the temple, the earlier sculptures, relating to Nandivarman, further explained by inscribed labels.[1] Thus, it is a structural copy of the Dharmarāja-ratha, with one more storey added, and, with its enclosure-wall of a shorter height carrying a *hāra*, recalls the larger *vimāna* of the Shore temple. This scheme of *hāras* over the enclosure-walls, as in the case of the Shore temple when viewed from outside (above, p. 134), gives the appearance of an additional *tala*, making the whole ensemble look like a *pañchatala-vimāna* or *mahāprāsāda*.

The other temples belonging to this period of structural activity are the Mukteśvara (pl. LIX), Mātaṅgeśvara, Airāvateśvara, Vālīśvara, Tripurāntakeśvara, Iravātaneśvara and Piravātaneśvara (pl. LX A), all in Kanchipuram, the Kailāsanātha at Tiruppattur and the Olakkaṇṇeśvara at Mahabalipuram. All these are composite varieties of *vimānas* with a varying number of *talas* and different types of *śikharas*. The Iravātaneśvara and the Tripurāntakeśvara are examples of *sama-chaturaśra-dvitala-vimānas* with *śikharas* of the same *Nāgara* plan. The Mātaṅgeśvara and Mukteśvara are *sama-chaturaśra-tritala-vimānas* with *vṛitta-śikharas*, characteristic of the *Vesara*. The Piravātaneśvara and Vālīśvara at Kanchi and the Kailāsanātha at Tiruppattur are respectively *sama-chaturaśra-dvitala*, *-tritala* and *chatustala-vimānas* with *ashṭāśra-śikharas*, typical of the *Drāviḍa* order. The superstructures of the Airāvateśvara and Olakkaṇṇeśvara are not extant. The Chandraprabhā shrine in Tirupparuttikkunram is an example of *sama-chaturaśra-tritala-vimāna*, of which the middle storey is functional in that it contains a deity in worship, the ground floor being a solid construction forming a high platform. The top floor is again non-functional. All these are of sandstone, incorporating granite slabs as the base and top of the *adhishṭhānas* and containing shallow bas-relief sculptures on the wall.

The Mukunda-nāyanār temple (pl. LX B), built of a reddish variety of hard stone, indicates perhaps the first attempt to build a *vimāna* in all its parts of that material, evidently in the time of Rājasiṁha. This temple differs from those described above by its being a more plain and severe structure, a *dvitala-vimāna* with *Drāviḍa-śikhara*. The shrine-pilasters are devoid of lion- or *vyāla*-bases and are plain. Even the capital-members are roughly and disproportionately shaped, perhaps due to the hardness of the new material which had to be sculptured *in situ*, and whatever reliefs it had, such as the *makara-toraṇa* and figures inside niches on either side of the *mukha-maṇḍapa*, were of stucco picked out on the plain surfaces of the stone. It contains inside a Somāskanda-relief, and, as in the case of all the temples described above, this too does not have a *praṇāla* or water-chute on the northern side of the *vimāna*, though there is a cylindrical polished *liṅga* occupying the centre of the shrine.

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[1] *South Indian Inscriptions*, IV (1924), no. 135; C. Minakshi, *The Historical Sculptures of the Vaikuṇṭhaperumāḷ Temple, Kāñchī*, Mem. Arch. Surv. Ind., no. 63 (Delhi, 1941).

The Tālagirīśvara temple at Panamalai (pl. LXI) also constructed by Rājasiṁha, is another temple interesting in its plan and material of construction. Like the Mukunda-nāyanār temple, it is of a harder coarse-grained stone, a reddish granite. It is essentially a *sama-chaturaśra-tritala-vimāna* facing east with small oblong shrines attached, as it were, to its south, west and northern sides facing the respective directions. These lateral shrines, which stand on the projected *adhishṭhāna*, are of the *āyatāśra-dvitala* type with *śālā-śikharas* taking the place of the *bhadra-śālās* of the main *vimāna*, while at the corners of the main shrine are *karṇa-kūṭas* not projected as in the Kailāsanātha at Kanchi; in between the *karṇa-kūṭas* and *bhadra-śālās* are shown *pañjaras* forming the *hāra* over the *prastara* of the first storey of the main shrine. This scheme is repeated in the second storey, which is extant in original form. The topmost or third storey is a brickwork reconstruction. The main *vimāna* and its projections are cantoned at each corner by a rearing lion or *vyāla* pilaster. There is a Somāskanda bas-relief inside the shrine on the back wall enclosed by the framework of a full *vimāna*-front and a *dhārā-liṅga* in front on the floor, sculptures of Brahmā and Vishṇu on the inner walls of the *ardha-maṇḍapa* and two *dvāra-pālas* on either side of the *ardha-maṇḍapa*. The place of the *bhadra-śālā* is taken by the *ardha-maṇḍapa* on the eastern side. As in the case of the Shore temple, the corners of the various storeys carry squatting *bhūtas* blowing conches. But there are no sculptures on the outer walls of the shrines as in the sandstone examples, and the carvings are reduced to the minimum, though there are some showing an advance over the Mukunda-nāyanār temple in this respect. The hardness of the stone obviously was the deterrent for the sculptural embellishment.

The *adhishṭhāna* portions of the Vaikuṇṭha-perumāḷ and the Sundaravarada-perumāḷ temples at Uttiramerur, both of them bases of large *vimānas*, complex in design, are of finely-moulded and carved granite belonging to the time of Dantivarman and show that sufficient skill had been achieved in working the hard material and fitting it into the structures. While in the case of the Vaikuṇṭha-perumāḷ, the niches, as in the Mukunda-nāyanār temple, were made to contain stucco figures and not slab-reliefs of appropriate size fitted into them, the Sundaravarada-perumāḷ temple shows an advance in that the sculptures placed on the three side-projections of the *adhisṭhāna* are good bas-reliefs on granite slabs, indicating their general use from about this period.

The apsidal Vīraṭṭāneśvara temple at Tiruttani is a very good example of an *ekatala-gajapṛishṭhākṛiti-vimāna* in fine-grained black granite, as the foundation-inscription on it says.[1] It was built in the time of Aparājitavarman, one of the last rulers of the Pallava dynasty (end of the ninth century). In addition to the structural achievement, it contains, like the earlier examples at Uttiramerur, good bas-reliefs in the same material fitted into the niches of the *vimāna*-wall and in front of the *śikhara*. The apsidal south-facing shrine in the precincts of the Bhaktavatsala temple at the foot of the hill at Tirukkalukkunram, now used as the temple-treasury, is also an example of a late Pallava *gajapṛishṭhākṛiti-vimāna*, but its superstructure is lost. Judging from its simplicity, it was perhaps slightly earlier than the Vīraṭṭāneśvara temple and was probably built in the time of Nṛipatuṅga.[2]

The ruined Śiva temple at Solapuram near Vellore was built in the reign of Kampavarman[3] (middle of the tenth century), but the original moulded *adhishṭhāna*, a few sculptures and pillars alone now stand as remnants of the original construction in granite.

[1] *South Indian Inscriptions*, XII (1943), no. 94.

[2] It is earlier than the twentyseventh year (A.D. 897) of Āditya Choḷa, who conquered Toṇḍai-maṇḍalam, as the inscription on its walls would indicate. *Epigraphia Indica*, III (1894-95), pp. 277 ff.

[3] *Epigraphia Indica*, VII (1902-03), p. 193.

A general feature of all these Pallava structural temples, as of the monolithic *rathas*, is the absence of the water-chute or *praṇāla* usually found on the northern side of the shrines of later periods to take off the *abhisheka*-water from inside the *garbha-gṛiha*. In some cases they are found to be inserted later and are not original. This would indicate that the object of worship inside the cella (*mūla-bhera*) was a painted and decorated wooden or stucco relief which was not to be bathed. Even if *liṅgas* were installed, the *abhisheka*-water was perhaps collected in vessels inside the cell itself and taken out. From clues extant in many cases, the *liṅgas* from the time of Rājasiṁha appear to have been only secondary, the principal object of worship being the Somāskanda on the back wall of the shrine. Towards the close of the Pallava period, Somāskanda gradually disappears from the back wall of the Śiva shrines and the objects of worship, whether *liṅga* in Śiva shrines or other forms of the consecrated deity in other shrines, are found to be placed at the centre on the floor.

A very good example of a Pallava *maṇḍapa* of this period with lion-pillars in granite is to be found in the Vishṇu temple at Kiliyanur. The Vaḍamallīśvara temple at Oragadam, included by Longhurst as a Pallava temple,[1] is really a much later structure. Similarly, the Gudimallam temple[2] is of the Choḷa times. Such apsidal temples continued to be built by the Choḷas particularly in Toṇḍai-maṇḍalam long after the Pallava rule, and there are many extant examples.

The close of the Pallava rule, i.e. the times of Nṛipatuṅga, Aparājita and Kampavarman, marks also the rise of the Choḷas of the Vijayālaya line to power, with their capital at Tanjavur, in the middle of the ninth century, and it is the Choḷas who took up the tradition of construction and sculpture in harder stones and further perfected it during their rule of three centuries. The practice was continued by the later dynasties that succeeded each other in this part of the country.

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[1] A. H. Longhurst, *Pallava Architecture*, pt. III., Mem. Arch. Surv. Ind., no. 40 (Delhi, 1930), p. 20.

[2] *Ibid.*, p. 23.

TECHNICAL SECTION

EXAMINATION OF RODS OF GLASS-LIKE MATERIAL FROM ARIKAMEDU

By Dr. B. B. Lal

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1. INTRODUCTION

THE excavation of the ancient site of Arikamedu, located on the Coromandal coast near Pondicherry in south India, yielded a large number of rods of glass-like material.[1] Recently, several specimens of similar rods from the same site were sent to the author by the Government Museum, Madras, for investigation into the composition of the raw material, particularly because, though the material seems to have been used for the manufacture of beads, the rods look so much like twigs that an opinion has been expressed that they might be fossil-wood and not glass, this suggestion receiving support from the fact that very near Pondicherry a large number of beds containing fossil-wood are found.[2] The present investigation was, therefore, undertaken with a view to determining the true nature of this material by microscopic examination and chemical analysis.

2. DESCRIPTION OF THE SPECIMENS

Most of the rods range from 2 cm. to 2·4 cm. in length, with a few specimens of larger dimensions, the longest being 4·6 cm., and have fine threading holes, which suggest that they were meant to be used for the preparation of perforated beads. In fact, they

[1] R. E. M. Wheeler, A. Ghosh and Krishna Deva, 'Arikamedu: an Indo-Roman trading-station on the east coast of India', *Ancient India*, no. 2 (1946), pp. 17-124.
[2] Information from Dr. A. Aiyappan, Superintendent, Government Museum, Madras.

have been described as long cylindrical circular glass beads.[1] Some are, however, solid without any holes, and several have been found to possess a core of sand. They are of various colours—olive-green, bottle-green, cobalt-blue, greenish-blue and brick- and liver-red. Most of them are opaque, but a few are transparent. Some show a whitish deposit on the surface, evidently the result of weathering caused by prolonged burial in the soil. Pl. LXII A shows some of the typical specimens.

3. EXPERIMENTS

A. Physical tests

Physical tests, such as refractive index determination, specific gravity measurements and hardness tests, were carried out on a very large number of the specimens. The refractive index (measured by Becke-Method) ranges between 1·4996 and 1·5383. [The refractive index of soda-lime glass is 1·53, that of quartz varies from 1·5442 to 1·5533 and of chalcedony and opal from 1·531 to 1·539 and from 1·40 to 1·46 respectively.]

The above data show that the refractive index of the specimens under examination is much higher than that of opal but is distinctly lower than that of quartz and approaches that of chalcedony; but that they are not chalcedony will be shown later. It is, therefore, obvious that they do not represent fossil-wood, as otherwise they should have conformed to the properties of opal and chalcedony, which produce fossils as a replacement of wood and other organic materials.

Specific gravity determinations have been carried out at a room-temperature of 25°C. on twentyseven specimens. The results are detailed in the Table on p. 141.

From the Table it is seen that with the exception of numbers 1, 2, 4, 18, 19, 23 and 25, which have a specific gravity higher than that of quartz, the specimens have a lower specific gravity ranging between 2·51 and 2·63. [The average specific gravity of soda-lime glass is 2·5.]

It, therefore, follows that although most of the specimens are lighter than quartz, their specific gravity is generally higher than that of soda-lime glass. Density, however, being a function of the molecular weight of the components of glass and varying over a large range, these results indicate that the material of which these rods are made is not quartz but is akin to glass. The higher density caused by the composition of the specimens suggests higher silica, lime and alumina content. The vitreous lustre and conchoidal fracture exhibited by the specimens also indicate their glassy nature.

The hardness of the specimens has been determined by using Mohs' scale of hardness. Generally, their hardness varies from 5 to 7; they are thus harder than modern window-glass. The hardness of a very large number is, however, distinctly below 7, the hardness of quartz. The specimens are, therefore, not composed of chalcedony or silica. The wide variation in hardness seen in the specimens is not surprising, as it is determined by their chemical constituents. It may be emphasized that although hardness and resistance to abrasion are important characteristics of glass, they are determined by the composition of individual specimens. The higher the proportion of silica, alumina and lime, the harder is the glass. High alkali content reduces the hardness, and soda-lime glasses are generally harder than potash glasses of the same composition. Moreover, the hardness of glass

[1] Wheeler and others, *op. cit.*, p. 101.



A. *Specimens of rods of glass-like material from Arikamedu* (× $\frac{3}{2}$).
See page 140



B. *Thin section of a specimen in ordinary light* (× 30).
See page 142



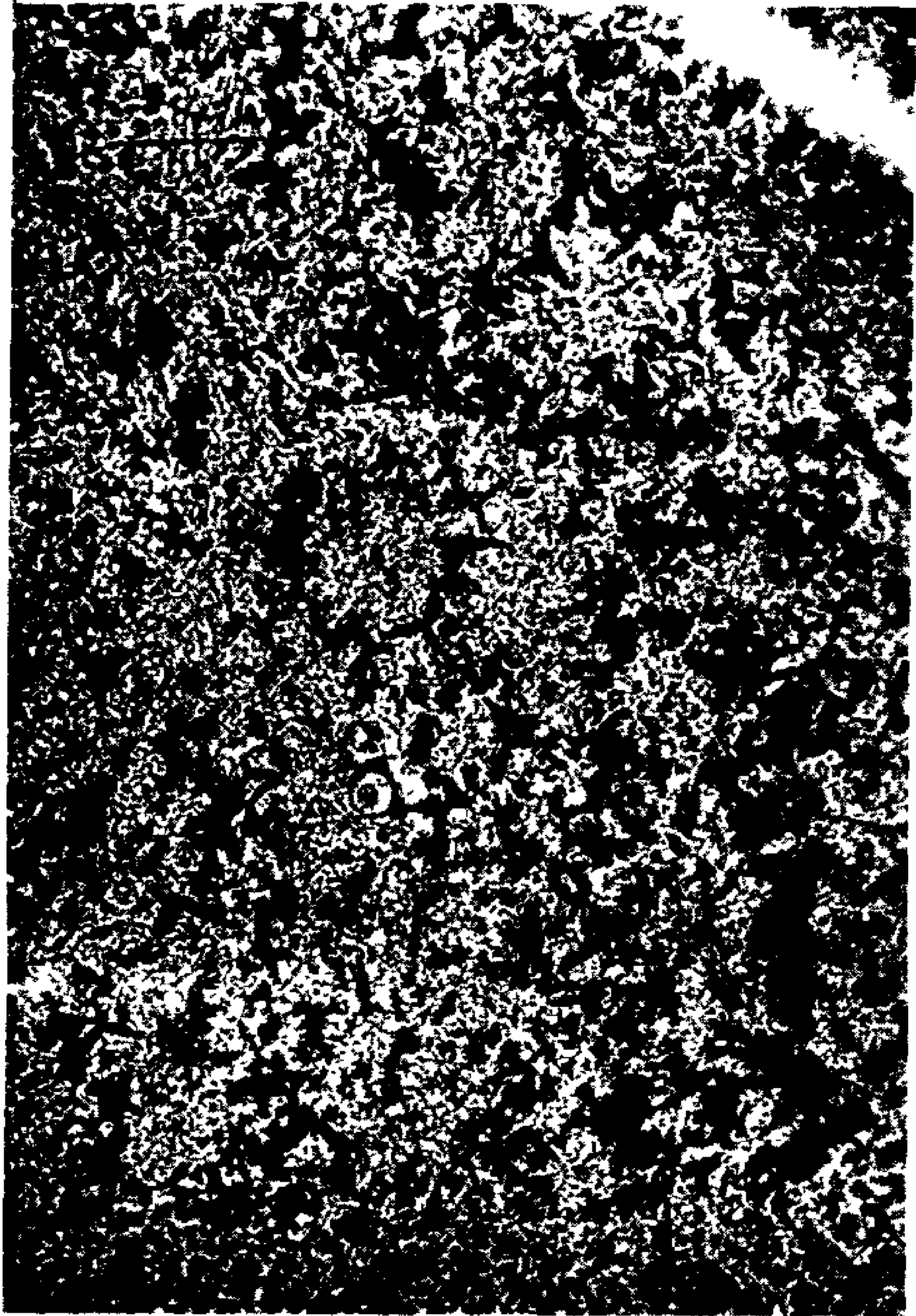
C. *Same as* B, *between crossed nicols* (× 30). *See page 142*



A. *Thin section of a specimen in reflected light showing signs of flow* (×6). *See page 142*



B. *Polished cross-section of a specimen under reflected light showing sand-core and flow of glass* (×6). *See page 142*



C. *Thin section of a liver-red specimen in ordinary light showing grains of colouring matter* (×70). *See page 142*

also depends on the heat-treatment to which the glass is subjected after working. Poor annealing and uncontrolled cooling at a high rate increase the hardness of glass. The variation in hardness shown by the specimens is, therefore, not unexpected.

TABLE SHOWING THE SPECIFIC GRAVITY OF THE SPECIMENS

Nature of specimens	*Serial no.*	*Specific gravity*
Green opaque specimens	1	2·91
	2	2·77
	3	2·60
Green transparent specimens	4	2·74
	5	2·57
	6	2·52
Red opaque solid specimens	7	2·55
	8	2·64
	9	2·51
	10	2·58
	11	2·54
	12	2·54
	13	2·60
	14	2·54
	15	2·58
Red opaque perforated specimens	16	2·54
	17	2·63
	18	2·65
	19	2·70
	20	2·54
	21	2·59
	22	2·63
	23	2·72
	24	2·61
	25	2·67
	26	2·59
	27	2·57

B. CHEMICAL ANALYSIS

The glassy nature of these specimens has been further established by chemical analysis. In a typical analysis, the alkali percentage was found to be 13·22 which agrees with the alkali content of common glass.

C. MICROSCOPIC EXAMINATION

That the specimens are not fossilized wood has also been established by microscopic examination. Thin sections of several specimens were prepared in accordance with the

standard method used in petrological examination of rocks. Leitz Panphot universal microscope was used for microscopic examination of the specimens in transmitted and reflected light. Under the microscope, the specimens do not show any trace of plant-structure. A thin section prepared out of a small solid specimen shows in transmitted light a core surrounded by glassy material.

The grains of the core are anisotropic, but the surrounding material is perfectly isotropic between crossed nicols, as seen in photomicrographs (pl. LXII B and C). Had the specimens been composed of fossilized wood, the material would have been anisotropic and cellular structure of wood preserved in opal would have been present, and an aggregate structure would have been seen between crossed nicols (indicating chalcedony). Actually, however, only the core shows some anisotropic grains of quartz and the remaining material is completely isotropic.

A thin section prepared in the above manner was microscopically examined in reflected light. The core of sand is very clearly seen in the photomicrograph (pl. LXIII A), surrounded by compact glassy material having wavy bands of a differently coloured material.

A solid specimen was cut across, and the freshly-cut surface was carefully polished for examination under reflected light. The result is shown on pl. LXIII B. The photomicrograph shows the inner core of grains of sand (light-coloured grains) surrounded by a compact material having wavy bands of a differently-coloured material. Had the specimen been composed of fossilized wood, the cellular structure would have been uniform throughout the surface. The presence of the wavy bands can be accounted for only by the fact that the material had been drawn out in the form of tubes in the molten condition. These wavy bands, therefore, represent flow-lines exhibited by glass.

D. Colouring matter

That the material of the rods is artificial glass and not fossilized wood is further proved by an examination of the colouring matter of the specimens. The specimens show different colours, green, blue and red, and these colours have been found to be due to metallic oxides. Fossilized wood is not likely to show such colours. For example, one brick-red specimen has been found to contain oxide of copper. A thin section of this specimen was examined in transmitted light at a magnification of 70. Pl. LXIII C shows the structure so observed: numerous grains of opaque material (dark specks) are seen disseminated in a glassy matrix. They appear red under reflected light. The colouring material has further been chemically identified to be red oxide of copper (cuprous oxide). That is it not metallic copper has been established by silver sulphate-sulphuric method of Fitzpatric.[1] For this purpose, the specimen was reduced to a fine powder, which was digested with silver sulphate and then filtered. The filtrate was found to be free from copper. This shows that the specimen contained cuprous oxide but was free from metallic copper. It is, therefore, clear that the colouring matter of the specimen is cuprous oxide, which imparts a brick-red to liver-red colour to the specimens.

The green colour of the specimens has been found to be due to copper and iron and the blue to cobalt.

[1] W. W. Scott. *Standard Methods of chemical Analysis*, 5th ed. (Lancaster, 1939) I, p. 394.

4. TECHNIQUE OF MANUFACTURE

In the early stages of the development of the glass-industry and the manufacture of glass objects, sand was used as a core around which molten glass was moulded for the preparation of the desired object. The art of moulding glass has been traced back in India to about fourth to third century B.C.[1] It is probable that this technique was adopted by the glass-workers of Arikamedu for the manufacture of glass beads, etc.

5. CONCLUSION

The rods of glass-like material unearthed at Arikamedu have been found to be composed of glass. Various metallic oxides have been used for producing glasses of different colours. The suggestion that these rods are fossilized twigs has been found to be untenable.

[*Received on the 11th March 1958.—Ed.*]

[1] B. B. Lal, 'Examination of some ancient Indian glass specimens', *Ancient India*, no. 8 (1952), pp. 17-27.

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